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MEDICAL AND PHARMACEUTICAL

NOTES.

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ON THE PRESERVATION OF HYPODERMIC SOLUTIONS.

BY EDWARD H. SQUIBB.

ON ERGOT AND ITS PREPARATIONS.

ON RHUBARB.

ON PHYSICIANS' POCKET CASES.

ON BUYING ALCOHOL AND DISTILLED SPIRITS.

ON A GENERAL APPARATUS STAND, UPRIGHT CONDENSER, PINCHCOCK, AND BURETTE STAND.

BY EDWARD R. SQUIBB, M.D.,

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Republished from the Proceedings of the American Pharmaceutical Association for 1873.

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MEDICAL AND PHARMACEUTICAL NOTES.

PROTECTION OF HYPODERMIC SOLUTIONS FROM CHANGE BY KEEPING.

It is supposed to be established by the investigations of Dr. Bourdon, M. Delpech, M. Gubler, and M. C. Paul, that the growth of confervæ is the only cause of the changes which commonly occur in solutions of the organic alkaloids and their salts; and that these confervæ decompose the alkaloids and consume a portion of their constituents, so that the solutions become weaker as the growths increase. Various methods have been proposed and used to prevent these growths, but thus far none seem more simple or more effectual than the addition of one or other of the phenols; and the crystallized carbolic acid is perhaps the most convenient if not the best of these. This carbolic acid being an irritant in proportion to quantity, and it being very important that solutions for hypodermic use should be as unirritating as possible, it becomes of some consequence to know how little of the protecting agent can be used with average success. The experience of several years in this laboratory, has shown that one volume of a five per cent. solution of crystallized carbolic acid, in sixty-four volumes of a solution of sulphate of atropia of the strength of two grains in each fluid ounce, will generally, but not always, protect it from change. The carbolic acid here bears the proportion of about one-thirteenth of one per cent., and this proportion proves quite unobjectionable for the delicate purposes of eye surgery. But once or twice in an experience of about six years, it has proved ineffectual for protection.

In the endeavor to answer this query with accuracy, the first result reached was, that accidental circumstances from

unknown causes, sometimes prevent the growth of these confervæ in solutions not protected at all; and also admit of their presence in and absence from different bottles of the same solution, without discoverable relation to the proportion of the protecting agency. A series of solutions prepared with care in August, 1872, some unprotected, and others with various proportions of carbolic acid, stood until May, 1873, many of them remaining without growths of any kind, while those which produced confervæ did so without discoverable relation to the protecting agency. Supposing that the atmosphere of a laboratory might be the cause of these confusing results, fresh solutions of acetate of morphia and sulphate of atropia were made, the former salt having proved to be the most easily attacked and the most rapidly changed. The bottles containing these solutions were placed for one week with stoppers out, in a hospital where such solutions were very liable to change. The solutions were then distributed into small vials, some without protection, and others with various proportions of carbolic acid. These vials were observed every week during the months of May, June, and July, until they ceased to show any farther changes. One vial of the solution of sulphate of atropia which was entirely unprotected, failed, from first to last, to show any signs of change. Two vials of sulphate of atropia solution, and one vial of a pair of acetate of morphia solution, all protected with small quantities of carbolic acid, also failed to show distinct evidence of confervæ. But with these exceptions, the entire number of twelve pairs exhibited a diminution of confervoid growths, in proportion to the quantity of carbolic acid added, until the proportion of carbolic acid reached, in the solution of sulphate of atropia, about one-eighth of one per cent., and in the solution of acetate of morphia about one-seventh of one per cent., all with larger proportions remaining clear and unchanged. Hence it appears that solutions of some salts, though of the same strength, require more carbolic acid for protection; but the proportion which under ordinary circumstances will protect the most difficult ones of those tried, does not exceed about one-seventh of one per cent.

But these solutions were all made with distilled water, and with more than ordinary care, and were all filtered. When similar solutions were made with ordinary undistilled water, nearly double the quantity of carbolic acid was required to afford a doubtful protection. Hence these solutions should, under all circumstances, be made with distilled water, and be carefully filtered.

The query may then be answered as follows: When such solutions are properly made, the smallest proportion of carbolic acid which will protect them from change, is about one-seventh of one per cent.; but that a proportion of one-sixth of one per cent. is practically better and safer in ordinary practice; and that this latter proportion is unobjectionable in all known respects. To make these solutions with this proportion, the following formulas are suggested. First, to make a five per cent. solution of carbolic acid, which is useful for this and many other purposes:

Take of crystallized carbolic acid 10 parts, or 10 grammes, or 154 grains; distilled water 200 parts, or 200 grammes, or 3086 grains. Weigh the distilled water in a glass-stoppered bottle, capable of holding one-fourth more than the sum of the quantities. Melt the crystallized carbolic acid in the stock-bottle by setting this in water warmed to about 50° C. = 122° F., and weigh the quantity by pouring it carefully into the bottle containing the water, as its sits upon the scale. Then shake the whole together until the carbolic acid is dissolved, and filter the solution through paper. Label it, "Solution of Carbolic Acid, five per cent."

Of this solution, about fifteen minims in each fluid ounce gives a proportion of one-sixth of one per cent.

For solution of sulphate of morphia, of the strength called "Magendie's Solution:"*

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* The original "Magendie's Solution," as given in "L'Officine de Dorvault," p. 242, is, 1 part acetate of morphia in 40 parts water, or about 16 grains in 640 grains of water. As used in the United States, however, it is made from either acetate, muriate, or sulphate of morphia, and in the proportion of 1 part in about 28½ parts water, or 16 grains in a fluid ounce (of 455 grains) of water.

Take of sulphate of morphia, solution of carbolic acid, 5 per cent., of each 2 parts, or 2 grammes, or 31 grains; distilled water, a sufficient quantity. Dissolve the sulphate of morphia in about 50 parts, or 50 grammes, or 775 grains, of distilled water; add the solution of carbolic acid, filter through paper, and pass distilled water through the filter, until the filtrate weighs 57 parts, or 57 grammes, or 883 grains. Label, "Solution of Sulphate of Morphia; Magendie's; about 3.51 per cent., or 16 grains in the fluid ounce."

BROOKLYN, August, 1873.

NOTE ON ERGOT AND ITS PREPARATIONS.

THERE is, perhaps, no better example of the unity of pharmacy with practical medicine than is seen in a review of the career of ergot in the Materia Medica. The relation is a closer one than that of interdependence, and the support of a common interest from different bases of support. It is rather the relation of a single cause to a single effect. If knowledge and progress in medicine may be represented by light, then the correlation of electricity, magnetism, and heat in lighting up the universe may not unfairly represent the correlation of pathological research, chemistry, and pharmacy in therapeutics.

From 1807, when Dr. Stearns, of Saratoga County, recalled professional attention to its use in medicine, its history in the Materia Medica is most varied and interesting; and, from a simple parturient and supposed example of a specific effect upon a single organ, it has come to be applied upon a broad general principle, and is already sufficiently studied to extend its utility beyond anything that could have been foreseen. If the influence of pharmacy could be subtracted from this beneficent result, as it cannot be, it is highly probable that the remainder would be comparatively small. The ergot in substance, or by infusion, or by tincture, could have advanced

slowly, if at all, to the present state of knowledge in its application. Professor Procter, in a paper published first in the Proceedings of this Association in 1857, p. 127, was the first to give uniformity and permanence to any preparation of ergot, thus rendering its systematic and accurate administration practicable by so simple a proceeding as the addition of an acid to preserve it from those changes and uncertainties which, for half a century, had stood in the way of any very accurate investigation of its nicer therapeutic effects. Various investigations, chemical and pharmaceutical, had gradually led to this, but the various extracts, fluid and solid, and the various preparations under the name of ergotin, had all seemed to partake of the perishable nature of the drug in substance, so that the administration could be neither accurate nor uniform. And without this factor of tolerably fixed and known quantities in dosing, effects must always be liable to such confusion and uncertainty as to render the difficulties of accurate investigation almost insurmountable.

Although it may be quite true that when the life of one, or the lives of two human beings depend upon the parturient effects of a dose of ergot, there is no better practice, nor any that is so safe, as the use of fresh ergot in freshly made powder, yet experience has abundantly shown that it is upon the age and condition of the ergot, rather than upon its being ergot, that the safety depends, and that this age and condition can rarely be known with that certainty which is necessary when human life depends upon it. Hence it is that the elements of greatest importance in the use of ergot, as indeed of the whole Materia Medica, are to get the drug in good condition, and then to preserve its activity from change, so that its quantities may be uniform; and this is pharmacy.

Modern investigation and experience have shown that the principal and prominent effect of the administration of ergot to human beings, in adequate quantity, is to cause contraction of the involuntary or unstriped muscular fibre wherever this is found. The gravid uterus being constituted principally of this variety of muscular tissue, this was the organ upon which its effects were first observed, and it was long

used as a parturient, both by empirics and by the medical profession, before its more general effects were recognized. One of the most important deposits of unstriped muscular fibre is that which constitutes the middle coat of the arteries, and any agent which causes contraction in this, diminishes the quantity of blood which passes through the vessels, and so modifies the nutrition of diseased parts. Hence the uses of ergot in cerebral and spinal congestions, in capillary hemorrhages, in bloody tumors, and especially in tumors and hemorrhagic affections of the uterus, such as fibroids, polypi, &c. As a parturient, a single dose or two is sufficient, and it matters little in what form or how that is given, if the quality be assured and the quantity sufficient. But for many of the other uses it requires to be taken for weeks or months in full and frequent doses, as the only means of keeping up its effects until the cure is established, and hence the prime necessity for a stable and uniform preparation of the drug.

The first requisite to any trustworthy preparation of ergot is, of course, a uniform good quality in the drug, and this is by no means easy to attain. The market is now overstocked with ergot at extremely low prices. Tons of it might be had at sixteen to eighteen cents per pound, but it is all so small as to render it almost certain that it is from oats, barley or wheat, rather than from rye, while its deficiency in odor and taste, and its uncleanness, forbids the idea of its being trustworthy. Most of it is imported in bags, and thus only by chance can arrive in proper condition. Much of it is contaminated with the seeds of various weeds, and requires much labor in cleaning, as the weed-seeds are often very bitter and may be poisonous. It is not unfrequently wormy, or bears the marks of having been cleaned from worms and worm-dust, to improve the chances of sales and profits. Occasional lots, and these often large lots, look as if they had been washed, and suggest the idea of having been partially exhausted for the making of some of the so-called "ergotins." Hence it may be easily understood that to obtain a uniform supply of good ergot is a very difficult matter, even with the screw of price entirely taken off. Throughout the present crop the writer has paid

various prices, from $1.25 down to twenty-two cents, without always being able to get what was desired, though always on the alert in a large market, and always in the presence of far lower prices. Many good authorities state that wheat and oat ergot is as good as that from rye, and some even give the preference to that from wheat, but after many years of pretty close observation, the writer has failed to convince himself that these cheaper varieties are as good. They are certainly very inferior in odor and taste, and it is not an unfair inference, nor without natural analogy, that it finds better conditions for growth in its original and more natural habitat in the paleæ of the rye, where it certainly grows most vigorously.

The existence of one or more active principles in ergot, which may be isolated for therapeutic use, has been very generally believed, and various substances have been extracted and sold under the name of ergotin, those of different makers having different properties and different doses, but all producing some of the effects of ergot, though in very different degrees. After a careful attention to the literature of this subject, and comparing it with the results which seem to have been realized in practice by experience, the writer does not believe that there is an active principle separable from ergot which, in any proper sense, represents the drug. Like senna, rhubarb, and many other drugs, its effects seem to be dependent upon a natural association of its various separable elements. If this be true, there is no such thing as ergotin, and the various substances so called only represent the activity of the drug as they represent more or less perfectly its entire composition. Of course certain of its constituents, such as lignin, starch, fixed oil, gum, &c., are known to be inert, and such being excluded by the choice of a proper menstruum for extracting it, the nearer its preparations come to representing or containing all the remainder of the drug the better. The molecular constitution of the active portion of the drug seems, however, in its natural condition, to be loose, and like a slow fermentation, to be undergoing slow molecular changes, so that by age its peculiar activity is slowly diminished until finally lost. This process of change seems to be arrested by

acids, just as many other delicate slow changes are; and whether this be effected by the substitution of a more permanent acid for a less permanent one, in one or more salts, as has been suggested by Professor Procter, but not distinctly proved, or how it is effected, seems as yet unknown. It is, however, well established that the addition of about one per cent. of acetic acid, which is added to the officinal fluid extract of 1860, renders this liquid preparation permanent; at least the writer has known the same preparation to be continuously used as a parturient for six years without apparent change in activity, though watched closely for such change throughout the time, until the parcel on trial was all used. The ergot in the grain, however well kept, is known to become inactive without known change in appearance, though the sensible properties, such as the odor and taste, may, and probably do, change. Ergot in powder is known to diminish in activity much more rapidly than when in grain, and probably soon becomes inert. The tincture and wine of ergot are believed to change, though more slowly than the ergot in substance, whilst the extracts and so-called "ergotins" are all supposed to change more rapidly than the tincture. Much of this latter, however, is traditional, rather than exact knowledge, and must be presented as such.

There can probably be no better preparation of ergot than the officinal fluid extract of the U. S. Pharmacopœia of 1860.* The formula for this was published by Prof. Procter in the Proceedings of this Association in 1859, and the writer has made it continuously by this formula ever since. From this experience in making, which now amounts to many thousands

* In the last revision of the U. S. Pharmacopœia the formula and process for this fluid extract have been materially changed; first, by the introduction of glycerin, and next by adding the acetic acid to the preparation after the percolation, instead of percolating the drug with an acidulated menstruum. It is difficult to account for these changes in a preparation so well established and so well tried without known complaint. The addition of glycerin may have been to bring it into uniformity with other fluid extracts—a uniformity of very doubtful utility at best—but the change in the use of the acetic acid seems still more objectionable. The present officinal fluid extract will not serve to make the solid extract from.

of pounds, and from frequent opportunities of hearing of its activity and its effects, as well as of its permanency, the above statement of its value is made up. When given in frequent large doses for a long time, however, as is required for many of the more modern uses of the drug, it becomes very disagreeable, and occasionally deranges the stomach, producing nausea, loss of appetite, and consequent debility. Occasional intermissions in its use, with other suggestions of care and skill, will often relieve the stomach for a time without material intermission in the effects. It has also been often and much used by hypodermic injection, generally through the integument of the abdomen, in order to relieve the stomach, and it generally acts promptly and energetically when thus used, though in smaller dose; but from being loaded with organic matter, and containing alcohol and a little free acetic acid, it is very apt to produce small abscesses, and thus cause much suffering. Indeed it is by no means well adapted to hypodermic use, and such use of it has always been discouraged by the writer. It has also been frequently used as a topical application to the os uteri upon cotton-wool, but is equally inappropriate to such uses on account of the irritant action of the alcohol. Physicians who observe closely, and who by looking for effects get rid of the trammel of arbitrary doses, appear to be most successful in the uses of ergot, and such physicians often, if not generally, use this preparation in much larger quantity than the doses given in the older books. It is most frequently used in females, and for affections of the uterus, and here an excellent indication of its maximum useful effects is easily reached in most cases by the production of uterine colic. In the treatment of fibroids, polypi, &c., it is perhaps the best practice to begin with the standard dose, and increase this until uterine colic occurs, and then diminish the dose so as to come just short of this in the succeeding continuous administration. The dangers of ergotism or ergot poisoning seem to have been overrated, since the writer has diligently inquired for such results from those who use it most largely, but has heard of no instance of hurtful effect. Dr. A. Jacobi, of New York, who has probably used it as

frequently and in as large quantities or doses as any one in this country, with both adults and children, and who is competent authority, and a close observer, recently replied that he had never seen an instance of ergot poisoning, nor heard of one in the practice of his associates. Notwithstanding this, he and all careful practitioners are always most careful and most watchful in this respect, and probably their exemption from bad effects depends upon their seeing indications of danger before they reach the point of danger. Besides, it is probable that the ergot poisoning described as the result of eating ergotized food, &c., could only occur among an underfed, semi-scorbutic people; or under other conditions not present in cases ordinarily requiring medication by ergot. Dr. W. C. Wey, of Elmira, who has also used ergot freely, had at least one case in which it had been used in the treatment of a fibroid tumor of the uterus, with occasional interruptions, by the stomach, hypodermically, and topically, during a period of more than two years, not only without poisoning, but with great advantage.

In January of 1869, Prof. Langenbeck, of Berlin, first used what is loosely described as an "aqueous solution of secale" by hypodermic injection, in the treatment of aneurisms, with marked advantage. This practice is described in the Berlin Klinik Wochenschrift, and an epitome of the paper is published in Ranking's Abstract for July, 1870, p. 223. In the same Berlin Journal for 1872, Dr. Hildebrandt published the results of hypodermic injections of ergotin in the treatment of uterine fibroid tumors. This paper is epitomized in Ranking's Abstract for January, 1873, p. 248. This treatment when tried in this country seemed to be difficult and uncertain, for want of a trustworthy and uniform preparation which should fairly represent ergot, and be adapted to hypodermic use, and at the request of Drs. J. Marion Sims, of New York, and W. C. Wey, of Elmira, the writer undertook what seemed to be a hopeless task, of making a preparation well adapted to hypodermic use.

Disbelieving in the existence of any separable active principle in ergot at all analogous to the morphia of opium, no

preparation seemed available except an extract which should be soluble in an aqueous menstruum. Then knowing the difficulty with which non-diffusible extractive matters are absorbed when deposited in the subcutaneous cellular tissue, and the liability of such matters, however bland, to cause troublesome abscesses, the problem seemed to be impracticable. After a good deal of time and trouble given to the matter, and many complicated trials, which need not be detailed, the best practical result reached was that of making a solid extract of ergot by the evaporation of the fluid extract of the U. S. Pharmacopœia of 1860, at a very low temperature, by mechanical stirring.

If this fluid extract, carefully made by repercolation from good rye ergot, without any heat, be evaporated in a shallow capsule in a bath of water of 50° C. = 122° F., by active and continuous stirring, until it is reduced to one-sixth of the weight of the original fluid extract taken, the result will be a spongy extract of a light brown color, full of air incorporated by the mechanical agitation, and looking a little like pulled molasses candy. This extract has the full odor and taste of the fluid extract, concentrated by condensation, and probably has the full therapeutic value of the ergot from which it is made, and each grain of it represents six minims of the fluid extract, or six grains of the ergot from which the fluid extract was made. It is quite insoluble in cold stronger alcohol, but entirely soluble in diluted alcohol, and also is easily soluble in water, with the exception of an insignificant residue which is easily filtered out. Its solutions are slightly acid to litmus-paper, and have their ergot odor strongly increased by the addition of alkalies. The concentrated solution in water is turbid before filtration, but after filtration is of a rich deep garnet brown color. How this extract or its solutions will keep is of course unknown, but the probabilities of keeping unchanged are quite favorable in regard to the extract, but unfavorable for the aqueous solution. A five-grain pill of this extract of course represents the mean dose of thirty minims of fluid extract, or thirty grains of ergot, and it is not only much more easily taken, but in delicate conditions of stomach is much less

liable to produce nausea, loss of appetite, &c. It does not, however, always agree better with sensitive stomachs than the fluid extract, nor does the stomach always tolerate it much longer. Hence it is very desirable often to relieve the stomach altogether for a longer time than the brief intermissions that can be permitted without losing ground already gained by the treatment; and to effect this, hypodermic and topical administration may be resorted to. Hypodermic medication is merely a short cut into the circulation whereby the process of digestion and assimilation and the organs by which this process is effected are avoided, the absorption taking place directly from the cellular tissue. Hence the therapeutic action is more prompt; and in the case of medicines which are liable to decomposition in the process of digestion, or to loss by entanglement with the fecal matters, smaller quantities are required to produce a given effect. But then, as most medicines are irritant, or at best liable to act as foreign bodies when introduced under the skin, they will more or less frequently cause abscess and painful irritation, and this in proportion to quantity, irritant nature, and their being more or less loaded with matters which are not diffusible. The filtered aqueous solution of this extract of ergot, though not well adapted to hypodermic use, is better adapted to it than the fluid extract, and perhaps is as well adapted as any preparation of the drug can be under the supposed required conditions. Such a solution has been used in this way with variable success. In some hands it seems to have been moderately and usefully successful, in others less so, while in some it has produced abscess so often that it was soon abandoned. The solution may be made of almost any desired strength, but that which seems to have answered best is the same as the fluid extract, or a minim for each grain of ergot represented in the extract. To make this solution, sixty grains of the extract is weighed into a small vessel and dissolved in about four fluidrachms of water by stirring. It is then poured into a small wet filter supported over a vial marked for containing just six fluidrachms, and when the liquid has passed through, the filter is rinsed through with water until

the measure of six fluidrachms is reached. This solution should be made every week or two, or in summer more frequently, until its permanence be ascertained. If desired, it may easily be made of double the above strength by halving the proportion of water, but what is thus gained in the quantity of the injection is perhaps overbalanced by the disadvantages of density in retarding the absorption.

This same solution seems well adapted to use as a topical application, the desired dose being put upon a dossil of cotton-wool, and this applied to the os uteri, with another dossil behind it. It might be inferred that this would be a very imperfect method of administration, and when first proposed by Dr. Wey as an alternative method, the writer predicted its failure, not being then aware of a somewhat similar practice in Germany as long ago as 1836. Dr. Wey, however, succeeded well, and produced the characteristic uterine colic within two hours or less. This topical method may also be used by means of suppositories, and the best vehicle for the extract seems to be the mixture of gelatin water and glycerin, which, when in proper proportions, make a very firm jelly, wlich does not become hard, and keeps indefinitely. Beside, it melts at a gentle heat, and is readily soluble in aqueous liquids. This is but a nicer and more simple form of the compound used for the inking rollers of printers. It seems not improbable that oleic acid might be used as a vehicle for this extract, thus adapting it to dermic administration, but as yet no trials have been made.

Brooklyn, August, 1873.

NOTE ON RHUBARB.

The New York market has been very abundantly supplied with rhubarb of moderately good quality throughout the year, and always at low prices, ranging from 40 cents to $1 per pound. Neither the higher nor the very low grades have been as abundant as during last year. Since the fall in prices

some three years ago, half picul chests are more and more rarely seen in the market, and during the past year the writer does not remember to have seen one of smaller size than the whole or picul chest of about 165 pounds. All the grades seem better sorted, that is, more uniform in quality throughout each chest, than formerly, and it is rare to see the mixtures that were common some years ago. All the rhubarb of the common market of the past year has been notably deficient in the aromatic rhubarb odor. Even upon recent fracture, or when ground, it has only the feeble, rather nauseous, astringent odor, if an odor may be described as astringent, approaching that of ground nutgall. How or why it is that the old and valuable characteristic odor is so rarely met with of late years, even in the parcels of finest quality in other respects, seems without any probable explanation. This rather agreeable and peculiar aromatic odor has always been to the writer one of the very best indications in the selection of rhubarb, and he remembers that, in comparing experience and judgment with Professor Procter on this point some years ago, he found his opinion confirmed by that good authority. It may be suspected perhaps that the increasing demand for the drug may have caused it to be more rapidly cultivated or collected from new climates and new soils, and that more rapid processes of drying by artificial heat may have been adopted. These aromatic odors in vegetable substances in general seem to be characteristic of perfect maturity, and to result from natural processes which resemble fermentations. These processes seem to be delicate, slow, and sensitive, and yield aromatic ethers and phenols which are very volatile and diffusible, and have a very loose or easily decomposed molecule. Besides, these processes seem generally to pass on more or less rapidly, as in fruit, &c., from maturity into decay where an entirely new set of reactions are set up. Thus it is not perhaps an overstrained inference, or deduction from better known phenomena, to suppose that the aromatic odor of rhubarb is an indication of maturity and perfection, more pronounced in the better varieties and conditions of the plant, and better preserved in the drug by

some methods of curing than by others. Hence it follows that the aromatic properties may or may not be produced as the proper varieties in the proper soil may or may not be allowed to ripen. And when produced it may or may not be dissipated by artificially rapid, or by naturally slow processes of drying. However this may be, it is very certain that the aromatic properties of the finer qualities of rhubarb are so rapidly diminishing of late years, that it is rare to find a chest at this time which possesses this characteristic in moderate degree, even when the color, texture, and other sensible properties may be unexceptionable. This aromatic character is believed by many good authorities to be quite important in a therapeutic point of view, and this belief is earnestly concurred in and supported by the writer. Refinement in therapeutics must keep pace with the accuracy of observations and the delicacy of distinctions in pathological researches, in order to effect that symmetrical progress in knowledge which is the soundest and the most useful. The peculiar effects of rhubarb as a stomachic tonic, whereby it is so useful to a large class of dyspeptics, seem to be merely supplemented and aided by its aperient properties ; and these effects seem so intimately connected with its aromatic properties as to suggest the relation of cause and effect, and therefore make these properties, or the condition of maturity and perfection which these properties indicate and secure, an element of chief value. Well supplied as the market has been with good grades of rhubarb at low prices, chests of choice quality, either in color or texture, and more especially in odor, have been very rarely seen. And the London market, as represented by the writer's correspondents, has not offered a very much better selection than that of New York. Three samples are herewith submitted, which are fair specimens of as many chests which may perhaps be accepted as the very best grades offered by the London and New York markets during the past year.

The first sample in box No. 1, is from a chest of round rhubarb imported by Messrs. Dodge & Olcott. In the case of this chest, as in the others, every piece was bored to the cen-

tre, and separately examined. The cost was $1 per pound currency. About one-half the pieces are quite unexceptionable in color and texture, while almost all are perfectly sound, while the odor, though feeble, is better than that of any other chest seen in the New York market during the year. Not more than five or six unsound pieces were found in the chest, and the number of pieces which are discolored at the centre is not great, neither is the degree of discoloration in any of these very great. The texture is universally compact and the root heavy, but the apparent proportion of oxalate of lime is below the normal of finest grades, and the pieces, as in most round root, are not very dry. The selected root from this chest is of rather exceptionally good quality, and the powder made from the remainder is unexceptionable and yields a very nice fluid extract.

The second sample, in box No. 2, is from a chest of flat rhubarb, selected as the best in the London market, by Messrs. Arthur S. Hill & Son. The cost of this in London was 3 shillings and 4 pence per pound, which with the 10 per cent. duty, and charges, and gold premium, makes the neat cost of about $1.20 per pound. Less than one-half the pieces of this chest can be accepted as select rhubarb for the more delicate uses of the drug, though not one single unsound piece was found in the chest, and but few that were materially discolored in the centre. It was therefore better sorted, though not quite so good rhubarb as the first chest, though drier. The general color and texture were good, and the apparent proportion of oxalate of lime nearer to the normal of mature root than in the first chest, while the odor is neither quite so strong nor quite so good in quality; nor is the powder quite so nice, though perhaps practically unexceptionable for its best uses and effects.

The third sample, in box No. 3, should be examined after the others. It has the appearance of a trimmed, and otherwise artificially made up rhubarb, and it is very evident that much pains and skill have been artistically expended upon its appearance, and it is really very handsome indeed. It will remind any one at once of the handsome artificially prepared

Austrian rhubarb, which is constantly sold as "Turkey rhubarb" at high prices, but which is comparatively valueless in medicine. But the pieces are much larger, the texture appears different, and more than all the odor is that of the best variety of the old Russian rhubarb. Each piece is bored entirely through, just as the best Russian used to be, and the internal texture and color appear to be as typical as is the odor. None of the pieces have been broken, because the fractured surfaces can only be judged when freshly made. But if, when now fractured freshly for the critical inspection of the members present, the fracture and internal odor should sustain the character indicated by the external appearance, this is the finest specimen of rhubarb the writer has seen for many years, and is fully equal to the choicest parcels of the now long-extinct Russian drug. It seems to have been made from fine large mature roots of Chinese or Tartary rhubarb, dried, preserved, and prepared with much care. This sample is from the London market, and was sent to Messrs. Recknagel & Co., of New York, as representing a chest which was offered at 12 shillings sterling, equal to about $4.20 currency, in New York. It however found no buyer here until the writer ventured to send for it as an experiment, well knowing that it would be of very slow and doubtful sale, at small profit.

The fourth sample, in box No. 4, is from the cabinet of the writer. It is a specimen of undoubted Russian rhubarb, taken from a choice case in the writer's possession some ten years ago. Though carefully kept in a bottle in a dark closet, it has lost most of its odor, and become lighter in color, but still may serve as a standard for comparison.

Brooklyn, August, 1873.

NOTE ON PHYSICIANS' POCKET-CASES.

In the treatment of emergencies and acute conditions of disease, physicians often lose time which is most valuable by having to send for their remedies. Hence, within the past

few years it is not uncommon for them, even in large cities, to carry a pocket-case containing small quantities of a few important medicines, such as are needed most promptly, and can be easily dispensed at the bedside. In night calls such pocket-cases seem particularly useful, and some physicians use two, one being especially adapted to the wants of obstetrical practice. Indeed, it seems doubtful whether two small cases of four, six, or eight small vials be not always better and more convenient than one large one, even if they be both carried at the same time. The pocket-cases hitherto accessible have not seemed the best that could be devised, and have been defective in two important points, namely, the proper measuring out and labelling of the medicines. At the request of the local medical society, of which he is a member, the writer has tried to improve the cases and to remedy the defects.

As a rule, only liquids and pills should be carried in pocket-cases, and these in small quantities frequently renewed, so that vials holding from one and a half to two drachms are large enough for all ordinary purposes. The vials for liquids should be long and narrow; those for pills shorter and wider. The case should be of good morocco, not imitation, and should be light and strong. Spring locks or catches are poor at best, and often give much trouble by failing to lock, or by rapidly wearing out. Hence it is doubtful whether the supposed advantages of the flap and lock are real. The writer has, therefore, had some made, with a sliding cover like a common card case, for trial; but as these must be taken from the pocket by taking hold of the cover, should this become loose by wear, the case may drop out while the cover remains in the hand. Should this anticipated objection be not realized, this will doubtless be the best kind of case. These cases have either four, six, or eight vials in a single tier or row, or fourteen or sixteen vials in a double tier or two rows. Those with a single tier are not too thick for the breast pocket, but those of two tiers are too thick and clumsy for any ordinary pocket, except that of an overcoat, but may be more conveniently carried in the hand for night service, or in a vehicle. These larger ones are also serviceable as family medicine-cases,

either for home use or to take into the country, or upon travelling expeditions. One of the greatest drawbacks to the use of physicians' pocket-cases has been the absence of any means of dispensing or dosing the powerful medicines with which they are supplied with any degree of accuracy. All physicians know the fallacy of dropping liquid medicines either from the mouth of vials, or from any of the various dropping-tubes with any proper control of quantity, as no two liquids are alike in the size of the drop formed from the same vial or tube; nor are any two vials or tubes alike in giving the same size of drop with the same liquid. To meet this difficulty the writer has had minim measuring-tubes constructed and graduated to single minims. These are of three sizes, namely, fifteen, twenty, and thirty minims, so as to be adapted to the longer or shorter vials of the cases. They are simply straight graduated glass tubes drawn down at the lower end to a narrow orifice. They are used by plunging them into the liquid in the vial up to the minim mark, which indicates the desired quantity, or the quantity which can be taken out at one time, then closing the upper end with the forefinger, and transferring the charge to the vessel in which the doses are to be mixed. Having transferred the whole desired quantity by one or more charges from the vial, the tea or tablespoon by which the medicine is to be given, is used to measure into the vessel containing the medicine the number of spoonfuls of water to make the required number of spoonful doses. Holding the minim pipette over the vessel containing the medicine, pour one or more of the spoonfuls of water down over and through the tube, so as to rinse it thoroughly into the vessel below; then holding it firmly in the hand, by a rapid, sharp swing of the arm, throw the water out of it by centrifugal force. If the outside of the tube be now wiped dry, it may be returned to its place in the case with perfect security, that it will drain no water into the bottom of the case. The vials in the cases are made long and narrow, not only to give them strength and capacity, and the proper length for the breast pocket in which they then stand upright, but also because the case must be long enough for

the minim pipette, and the corked vials may be of this length without loss of space, and again because the long vials admit of larger quantities being taken out at one time by the measuring-tube or minim-pipette. These tubes take the contents from the vials in a much more neat and cleanly way than by dropping or pouring, and after a little experience in the use of them not a drop is spilled to soil the vial, label, or case. Such advantages, to say nothing of the improved accuracy of substituting minims for drops, far outweigh the trouble of only being able to take out a few minims at a time when the vial is nearly empty. These tubes, from having straight sides and a pretty uniform calibre, are much more easily graduated to a moderate degree of accuracy than the common minim measure; and almost any one can make them, it being only necessary to stop the small orifice at the lower end of the tube, pour into it thirty minims of liquid, mark the surface of the liquid upon the tube, empty the liquid out, and finally divide the space occupied by the liquid into thirty equal parts, by means of a common rule. Such tubes will be found very useful to the pharmacist in dispensing, if he will but break through old habits long enough to accustom himself to their use, for they remove accurately measured quantities from his bottles without soiling the neck or stopper, and do this easily and quickly. They will also be found useful to those far-sighted physicians who are now so wisely aiming at that accuracy in the administration of medicines, the want of which has so long obstructed the progress of therapeutics, for a physician can quickly and easily instruct patients, nurses, and attendants in their use, so that doses may be accurately, clearly, and neatly measured at the time of taking. For example, how easy it would be with one of these tubes to direct a patient to put twenty minims of fluid extract of cinchona in a half wineglassful of wine, and rinse off the used end of the tube by dipping it into the mixture, and shaking out the last drop into the wineglass before swallowing the mixture, then setting the tube upright in the wineglass, and putting all away until the time for the next dose. By some such means that desirable accuracy and uniformity of dosing may be attained

which alone gives much value in comparing and accumulating the results of therapeutic experience with the Materia Medica. The facility with which these pipettes are made renders them inexpensive, so that if the demand should call for them in any moderate quantities, they could be furnished by the pharmacist at a very moderate cost, and their scope could easily be extended to sixty minims without the objectionable necessity of using suction in charging them.

The other supposed improvement in the physicians' pocket-case is to supply with each case a list of labels of proper size for the vials, which list may embrace most of the articles needed on emergency, or particularly useful to have in hand at the bedside in cases of disease where saving of time is an important element of success. This list embraces forty-four articles of the active Materia Medica in their most potent and concentrated form, and from such a list it is supposed that each physician can make a selection of those which he most desires to carry. The articles of this list are as follows:

Fluid Extract of Aconite Root.
" " American Hellebore, or Veratrum Viride.
" " Aromatic Powder.
" " Belladonna Leaf.
" " Belladonna Root.
" " Buckthorn Bark.
" " Digitalis.
" " Ergot.
" " Gelsemium.
" " Indian Hemp.
" " Ipecacuanha.
" " Licorice Root.
" " Nux Vomica.
" " Podophyllum.
" " Rhatany.
" " Rhubarb.
" " Senna Compound.
" " Valerian.
Solution of Chloral, one grain to the minim.
Solution of Sulphate of Morphia, Magendie's, $\frac{1}{10}$th of a grain to the minim.
Solution of Sulphate of Atropia, 4 grains to the fluid ounce.
" " Quinia, $\frac{1}{4}$th of a grain to the minim.
" " Zinc, 10 grains in 30 minims.
" Subsulphate of Iron.

Compound Tincture of Ipecacuanha, each minim equal to one grain of Dover's Powder.
Deodorized Tincture of Opium.
Compound Solution of Opium.
" Tincture of Opium, or Diarrhœa Mixture.
" Spirit of Ether, or Hoffman's Anodyne.
Purified Chloroform.
Tincture of Chloride of Iron.
Pills of Aloes and Mastic, Lady Webster's Dinner Pills.
" Arsenious Acid, $\frac{1}{20}$th of a grain in each pill.
" Opium, 1 grain each.
" Sulphate of Quinia, 3 grains each, or 2 grains each, or 1 grain each.
Compound Cathartic Pills.
Mercurial, or Blue Pills.
Podophyllum, or May-Apple Pills.
Compound Pills of Scammony, or Triplex Pills.
Nitrite of Amyl.
Calomel.
Mercury with Chalk.

All pills should be carried in short, wide vials, as the longer and narrower ones, being intended for liquids only, will not admit pills. Indeed, it will be generally found most convenient to carry everything in liquid form so far as possible, and to have a separate case for pills and powders when these are carried.

To facilitate dispensing at the bedside, the compound powder of ipecacuanha, or Dover's powder, is here offered in a liquid form. Perhaps few articles are more frequently desired at the bedside, particularly at late evening visits, than a Dover's powder; and when the physician has it in his pocket in a fluid form, with the means of easily and accurately dispensing it, he can often command a night of repose with very little trouble. This preparation is made by repercolation from the officinal ingredients, except the sulphate of potassa, in the officinal proportions, by the use of diluted alcohol as a menstruum, or by mixing deodorized tincture of opium with fluid extract of ipecacuanha in proper proportions, and evaporating the mixture by a water-bath until each ten minims represents one grain each of powdered opium and ipecacuanha.

Many of the articles of the above list are therapeutic alternates or duplicates, but they are offered to conciliate individ-

ual preferences, and future experience may lead to the dropping of some of them, and the substitution of other articles. Such preparations as the fluid extracts of aromatic powder, and of licorice root, cannot be considered as necessities in any other sense than because their use as corrigents will often enable the dilutions of other more active medicines to be given to children and sensitive persons with less difficulty. The skilful use of such corrigents by physicians and pharmacists would tend to free them from the "elixir" nuisance.

There is nothing whatever about these supposed improvements in pocket-cases that is of a proprietary character, and the writer deprecates the use of his name in connection with them. Those who make graduated measures will make the minim pipettes for any person who wants them, and the sheet of labels is printed without the name or address of any one, so that they carry no responsibility for the quality or make of the preparations they cover. The makers of such wares will make the cases for any one who may choose to order them, and make them to order from any class or quality of material and workmanship, and already cheap ones are in the market made of imitation material. In short, any one is at liberty to make them or have them made, and their defects may thus be found out and remedied.

BROOKLYN, September, 1873.

NOTE ON BUYING ALCOHOL OR DISTILLED SPIRITS.

WITH A TABLE AND WOODCUT ILLUSTRATION.

THAT the real interest of the buyer and the seller are the same in all bargains, is a truth long ago proven and illustrated in all social intercourse. Yet the reverse of the proposition is practiced as the common basis of mercantile transactions, even in the present day, of more accurate reasoning and more extended foresight.

This condition of antagonism of interest between buyer and

seller must however be accepted, though under protest against the error as one which supports a world of evil upon its broad shoulders. From this error springs the necessity that, from the consumer all the way back to the producer, the buyer must guard his interest *against* the seller; and also the circumstance that the rules and customs of the producer in the sale of his products, are not the safest nor the best for the consumer, whilst the interest of the producer is powerful, compact, and highly educated, in comparison with that of the consumer.

This is notably the case in regard to alcohol and all spirits, and because the producer has always represented the most active and compact interest, his counsels have always prevailed in the schemes which the governments of Great Britain and this country have adopted, for collecting a revenue from spirits. But because the older government clings to, and the other adopts a plan for collecting the revenue from spirits, which plan is not up to the knowledge of the day, is no reason why the consumer should continue to accept it, without from time to time, as knowledge advances, applying the test for greater accuracy and greater utility; since not even government authority can permanently establish that which is inferior in truth or utility, against the progress of knowledge.

Pursuing the subject of economy in the use and management of alcohol, so often presented to this Association by the writer during past years, he now begs to offer some objections to the common methods of determining quantities in the market for spirits, and to suggest improvements, which if practicable, may tend to harmonize the interests of the consumer and producer, and thus foster the true interests of trade. These suggestions are all based upon controlling quantity, by the simple and easy centesimal plan of Continental Europe. This centesimal or decimal method has, like the metrical system of weights and measures, met with a resistance from the governments of Great Britain and this country, which could hardly have been expected, and with regard to the metrical system, this resistance is only now giving way before that power of advancing knowledge which may be retarded and hindered but cannot be stopped.

Alcohol and water *combine* in all proportions. That is, as the union of the two substances is attended by the development of heat, and by contraction in volume, the result is a *combination* and not a *mixture*. Any given volume of water expands slowly at an unequal rate, as it is either warmed or cooled from its point of maximum density (3.945° C. = 39.101° F., Playfair and Joule), without change in weight. Alcohol also expands at an unequal rate, but it expands or contracts throughout the whole range of known temperatures. That is, it has no known point of maximum density. Its rate of expansion at ordinary temperatures is about five times that of water, and the inequalities or irregularities of its rate of expansion are different from those of water. Beside this, combinations of alcohol and water do not expand at the mean rate deducible from the rates of the two substances, but at a new rate peculiar to the combinations, or rather perhaps at a new rate peculiar to each combination of the two liquids. All combinations of alcohol and water are commonly called "spirit" or "spirits," and the alcohol of the combinations is the only element of value, and the only thing that is bought or sold, the water being a mere incumbrance that is bought and sold incidentally only. Hence every bargain is in reality for the sale and purchase of a definite quantity of absolute alcohol, and involves some plan of determining this quantity to a practical degree of accuracy; and, whatever plan may be used the result is commonly expressed in percentage, or by the number of hundredths of alcohol which the given combination of alcohol, water, and impurities contains. Two quantities, therefore, have always to be determined to the mutual satisfaction of seller and buyer. First the quantity of the combination, and next the quantity or proportion of alcohol which the combination contains. The circumstances alluded to above render these determinations somewhat complicated, and difficult to understand correctly, thus opening the way to abuses which pass unchallenged for years, and have a strong tendency to grow. So long as the stronger grades of alcohol were bought and sold at the low prices of 40 to 60 cents per gallon, shortages, the sum of which did not exceed

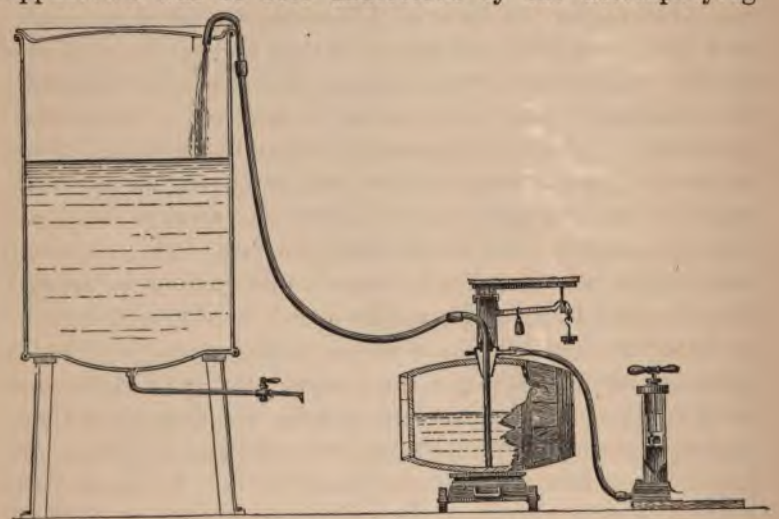
3 or 4 per cent., were not very important, and were suffered, because of the cost of reforming the plans, or through want of intelligence in buyers. But now that the same grades of alcohol cost nearly four times more, the shortages become proportionately important, and it is high time that buyers should so educate themselves as to be able to check and control their quantities if they choose to do so, and have that advantage of knowledge over ignorance, which legitimately and fairly belongs to him who knows his market.

The first determination of quantity, that is, of the quantity of the combination, or so-called mixture of alcohol and water, commonly known as "spirits" or "distilled spirits," or "high wines" or "alcohol," is made by capacity measure, and the result is stated in gallons. This measurement is generally made by gauging, and this gauging of casks and barrels is generally done by the straight gauge-rod and wantage-rod. Now, apart from the difficulties of temperature and the gauger's method of observing it, there is in this plan of measurement a good chance for many errors, which should not be unknown at the present cost of alcohol. Casks and barrels are not uniform in shape, though the same rule is applied to all. The stave opposite to the bung-stave may be thinner than the other staves. The staves and heads may be either thin or thick, yet must be chamfered down very thin at the chimb, where the gauge-rod touches the angle between stave and head, and the wantage is calculated upon an ideal bilge which can only be realized by accident. Hence, although gauging may be well adapted to the measurement of liquids the value of which is not above 50 cents per gallon, it is not accurate enough for liquids like whisky, high wines, alcohol, &c., whose value is from 90 cents to $2 per gallon. In other liquids the value of which has increased within the past few years, involving closer dealings and smaller profits, capacity measure is rapidly giving way to weight; and olive oil, linseed oil, castor oil, &c., are now sold and bought by weight, though some are in the transition stage as yet, that is, bargained for by the gallon, yet the number of gallons ascertained by weight on the basis of so many pounds and ounces to the

gallon. But even if the plan of gauging be susceptible of the accuracy for which it has general credit and acceptance, no such accuracy has been realized in the experience of the writer, who has for many years been a buyer of alcohol in the common market, and has always measured or weighed it as received. The aggregate result of this experience of many years is that, with occasional rare exceptions of over measure, a large proportion were either correct or less than a half gallon short (which latter was always accepted as correct). But a very considerable proportion of the barrels were from half a gallon to a gallon short, thus making a very constant average loss to the buyer, until a special bargain was made in regard to shortages. This special bargain of late years has been that where any barrel falls short more than half a gallon the whole shortage upon it is claimed and allowed. This bargain, of course, nets a loss to the buyer, but a loss which has fixed limits. Beside, any such bargain makes a buyer a troublesome customer to the seller, since the latter never knows when he is free from these claims for shortage. Of late years the writer has made all his remeasurements by weight, and the convenience and saving of time and saving of alcohol by this device have been so great, that it can be confidently recommended to all who desire to control or check their quantities. It is only necessary to take the specific gravity of the alcohol by an hydrometer, roll the barrel on to a scale, take its gross weight, empty it into the storage tank, and take the weight of the empty barrel for tare. This yields the net weight, which is easily turned into gallons as follows. The so-called U. S. legal standard gallon is 58,372.1757 grains at 39.83° F., which is equal within practical limits to 58,320 grains at 60° F. Suppose the specific gravity of the alcohol to be 0.817 at 60° F., then the process for accurately determining the weight of a gallon of it at 60° F., would be as follows: As 1.000 (= distilled water at 60° F.) is to 0.817 (= the specific gravity of the alcohol at 60° F.), so is 58,320 (= weight in grains of 1 gallon of distilled water at 60° F.), to 47,647.44 (= weight in grains of 1 gallon of the alcohol at 60° F.). This last number of grains is equal to 6 pounds, 12

ounces, and 397 grains, or practically 6 pounds and 13 ounces, and this being the weight of 1 gallon, it has only to be divided into the total weight of the contents of the barrel to get the number of gallons. The rule for practice deduced from the above process, is simply to multiply the weight of a gallon of water by the specific gravity of the spirit, when the product will be the weight of a gallon of the spirit. To render this plan easily practicable, the writer has calculated the weight of a gallon of spirit for each per cent., both by weight and by volume, and gives the results in a table herewith presented.

Some means of avoiding the loss of time and of alcohol in transferring it from the barrels to the storage tank, was for a long time much needed by the writer. This is of late very satisfactorily accomplished by condensing air on top of the alcohol in the barrel, by means of a common air syringe, and thus forcing the liquid out through a pipe which leads it into the tank. This simple device is a mere application of the principle of the old "amorce-siphon" of the French, and this application will be best understood by the accompanying



woodcut, which has been prepared to illustrate it, the block being offered herewith for the use of the Association, should it see fit to give this paper a place in its Proceedings.

A hollow, conical cast-iron bung, made with a screw-thread upon its exterior, such as is in common use to hold the pumps by which petroleum is transferred, is bored and tapped on top and at the side. Into the upper hole is screwed an inch nipple, and into the side hole a three-eighth inch nipple. Through the upper nipple is passed a piece of three-fourths inch block-tin or tinned copper pipe, down to the lowest part of the bilge of the barrel, and the lower end of this pipe is deeply serrated. The upper end is bent at a right angle, and is slipped into an india-rubber tube which leads to the tank. Where this tube passes through the nipple the parts are made air tight, by passing through a short section of rubber tubing, which fits tightly upon the tube above, and is stretched over the nipple below. The smaller nipple at the side is connected with a similar nipple on the air syringe, by means of rubber tubing, when the arrangement is complete. If now the iron bung be screwed into the bung-hole of the weighed barrel of alcohol, and the tube be pushed down till it rests upon the stave opposite to the bung-hole, the device is ready for the operation. If the barrel be nearly full a very few strokes of the pump will so compress the air on the surface of the alcohol, as to start the stream out through the central pipe into the tank, and from four to six minutes is sufficient to empty a barrel, and this without the loss of any alcohol, except that which wets the inside of the tubing. When the last of the alcohol is forced into the pipe by the compressed air, the rush of expanding air which follows it, blows out every ounce of alcohol from both barrel and tubing into the tank. A common gas-fitter's air syringe answers well for this purpose, and a wooden bung can be made to answer very well.

The second determination of quantity to be made is the quantity or proportion of alcohol—absolute alcohol—which the given combination or mixture contains, and as the absolute alcohol is the real and only object of the buyer, this determination is very important, since the seller may wish to sell water at the price of alcohol if he can. At the present ruling rates for spirits in the market, each 1 per cent. or each hundredth part by weight of absolute alcohol is worth about

2 cents; a little less for the weaker spirits, and a little more for those containing over 92 per cent., but about 2 cents as an average from about 95 per cent. downward. Hence errors of 1 per cent. in strength involve differences of 2 cents per gallon in value. Then as apparent strength varies with temperature to the extent of about 1 per cent. for each 3° C. or 5½° Fahr., on an average throughout the whole range of the combinations, but amounts to nearly 1 per cent. for each 1° C. = 1.8° F. throughout the middle and stronger part of the range. Such differences of temperature are equal to about 2 cents per gallon, also, by the expansion produced.

The common method of determining strength, or the proportion of absolute alcohol, is by an hydrometer of metal or glass with an arbitrary scale, which denotes, not simple percentage, but a compound or complicated percentage, expressed in degrees above or below proof. This plan is so complex, that for the most part its rules have to be empirically followed without being understood, and its expression of results is so difficult to translate into the simple decimal proportions of hundredth parts, that had it been intended to confuse and mislead the millions of consumers for the advantage of the few thousands of experts who represent the producers, it could hardly have been better constructed. And from this comes the fact, that the masses of mankind who are interested in alcoholic liquids are so ignorant in regard to them; and therefore so careless and so easily deceived. Another circumstance which adds to the popular confusion in regard to the strength of alcoholic liquids, is the use of the term "percentage" and often "true percentage," to indicate two very widely different ratios of strength. The words "per centum," "by the hundred," in their meaning apply equally to computations by weight or by volume, but by general consent and common usage, the term per cent. when not qualified means per cent. by weight, that is, the number of pounds, ounces or grains in the hundred, or a decimal relation by weight only, unless the sense forbids this, as in cases of tale or count. The reason for its general acceptance as a relation by weight appears to be that this idea is far the most simple, and most easily under-

stood, and must always be the basis of all accurate computations. In its application to alcoholic liquids, however, it generally, though not always, indicates volumes, that is, 95 per cent. alcohol generally means a combination which contains 95 volumes of absolute alcohol in the 100 volumes of the combination. But as a given volume of absolute alcohol weighs less than eight tenths of the same volume of water at the same temperature, this 95 per cent. by volume becomes about 92 per cent. by weight. Thus the expressions, though differing by about 3 per cent., are equally true for the same thing, whilst the lower is the best and most simple relation. The higher, however, suits the seller best, and is often spoken of as "the true percentage" without the qualification "by volume." Now as specific gravity must always be the basis of every method of determining strength, and as this is and must always be a simple relation by weight, the volume remaining constant, the sooner all other relations are rejected the better. Hence this determination of quantity, which must always be made by specific gravity, that is, by weight, should only be expressed in the terms in which it is made, namely, by weight; and all degrees, whether of any arbitrary scale, as that of Baumé, or above or below proof, or percentage by volume, should be discouraged and disused as rapidly as possible.

The disturbing influence of temperature is also a grave complication in this determination of strength, since, as above stated, an average of about 3° C. $= 5\frac{1}{2}$° F., is equal to about 1 per cent. or 2 cents per gallon for the stronger grades of alcohol. Observations must be made within this limit of temperature, therefore, to get within 1 per cent. of true strength. Most determinations and researches have been made and most tables are constructed for a temperature of 60° F. $= 15\frac{5}{9}$° C., and hence corrections for temperature are indispensable to any useful degree of accuracy. Such corrections are difficult and complicated except when made by tables, and convenient and compact tables are rarely at hand, so that the best and most convenient plan is to bring the liquid to a given temperature in order to make the determination. The standard

temperature of 60° F. = 15⅝° C. is not a natural one for living-rooms or even for storehouses, and it is quite impracticable to reduce a sample from each barrel to such a temperature within a reasonable time. But if an equivalent for the standard temperature be adopted, and this be about the average temperature of liquids throughout the year in the houses of temperate climates, but certainly above this rather than below it, then a sample of liquid might be always quickly and easily brought to such a temperature by the warmth of the hand on the outside of the sample jar. About such a temperature the writer has found at 25° C. = 77° F. Now if the readings of an hydrometer be known for these two temperatures, namely, 15⅝° C. = 60° F. and 25° C. = 77° F., in the same liquid, then of course the two readings are equivalent, and it does not matter, in an everyday practical sense, whether the liquid be cooled down to the lower temperature or warmed up to the higher. For example, it is known that a given combination of absolute alcohol and water has a specific gravity of 0.8172 at 15⅝° C. = 60° F., and that this is equivalent to 92 per cent. by weight of absolute alcohol. Now, if this liquid be warmed up to 25° C. = 77° F. it will show by the same hydrometer an apparent specific gravity of 0.8091. Now, if an unknown sample of spirit give the latter reading at the latter temperature, the reading for the standard temperature would be equally known, and therefore, the strength would be 92 per cent. by weight.

The great drawback to a more common use of specific gravity as an indication of strength in liquids, is the difficulty or inconvenience of reducing the temperature to the low standard of 60° F., which has been of late years universally adopted, because the cooling of liquids down to that temperature is always tedious and troublesome, and during a large portion of the year is impracticable without the use of ice. But when the practical need and value of a test of strength which is so widely and so generally applicable is considered, it seems well worth while to attempt to overcome this great drawback, that the more frequent and common use of specific gravity may be encouraged in the hands of consumers.

In order to favor this, and to awaken buyers of spirits and alcohol who buy for consumption or actual use, to a little more intelligence and practical economy in the management of their interests in this important commodity, the writer has constructed a general table, not scientifically accurate, but sufficiently accurate for everyday practical use, and offers it herewith.

To get some facts as to the necessity for more knowledge as to what is bought for "95 per cent. alcohol" by those who really intend to have that grade of strength, the writer sent to twenty first-class pharmacists and druggists, and bought one or two pints of their best and strongest alcohol without regard to cost. The wholesale houses very generally charged 40 cents a pint, though sometimes 50 cents, while the retailers generally charged 50 cents. One wholesale house charged 35 cents, so that the intention to have and to sell the very strongest was very apparent. One sample only approached as near as 94¼ per cent. by volume. Specific gravity 0.8175 at 15⅝° C. = 60° F. Two other samples gave 0.8190, or a little more than 94 per cent. by volume. Ten were between 93 and 93¾ per cent. by volume, and seven were between 92½ and 93 per cent. by volume.

EXPLANATION OF TABLE.

This Table has no claim to scientific accuracy or precision, but only aims to be moderately correct to within one-half of one per cent. The maximum error for the readings of any single lines across the Table is scarcely more than one-quarter of one per cent.; but in some few instances where one line is compared with the next below it, the sum of the two errors will reach one-half of one per cent. In the columns for specific gravity the figure of the fourth decimal place is given only to qualify the value of the figure of the third decimal place; that is, when the figure of the fourth or last decimal place is 4, or less than 4, the three preceding figures are to be read and accepted as they stand. But when the figure of the fourth decimal place is 5, or is greater than 5, the figure of the third place is to be increased by 1.

As the hydrometers and thermometers of the ordinary market, with which the Table must be used, do not approach precision nearer than one-half of one per cent., all that could be very practically useful in the Table would be to get within their range of error. At least this is all that has been attempted.

So far as regards the relation between specific gravities and percentage, the Table is a mere compilation or copy from various good authorities, but as these authorities do not agree upon the starting-point, namely, the specific gravity of absolute alcohol, of course their Tables do not agree with precision when placed beside each other. Indeed it is very doubtful whether any of the authorities have yet obtained absolute alcohol; and therefore more accurate research upon this point is needed. The table of Fownes gives the specific gravity of anhydrous or absolute alcohol as 0.7938; that of Tralles gives it as 0.7946, both at $15\frac{5}{9}°$ C. = 60 F., and both as compared with pure water at the same temperature taken as unity. More recent investigation gives a lower density, and the writer has frequently seen it as low as 0.7934, but no tables have been constructed upon these better data.

As the Table is a long one, it is for convenience of reference divided into seven parts, each embracing a grade of spirits used for different purposes. The first and second parts are for weak liquors, the third for low wines, the fourth for whiskies, brandies, &c., the fifth and sixth for high wines, and the seventh for alcohol.

Although revised with care, and the voluminous calculations checked, and the results reviewed by their differences, it is yet not improbable that slight errors may have escaped detection.

The first column of the table contains the specific gravities at $15\frac{5}{9}°$ C. = 60° F., compared with pure water at the same temperature taken as unity, for spirit of every degree of strength, by the four scales or methods of stating strength now in common use, namely, percentage by weight, percentage by volume, percentage under and over proof, and percentage of proof spirit. The specific gravities for percentage by

weight are copied literally from a table by Fownes, given in his Manual of Elementary Chemistry, Amer. edition of 1869, p. 830. These are believed to be most accurate and trustworthy.

The specific gravities for percentage by volume are given from Watts's Dictionary of Chemistry, vol. 1, p. 84, *et seq.*, where they are quoted as determined by Tralles from the observations of Gilpin. This table is less trustworthy than that of Fownes only in adopting too high a specific gravity for anhydrous alcohol. It is not literally copied here; but where its specific gravities were within two or three-tenths of one per cent. of being the same as those of Fownes, they were accepted as being practically in accord with Fownes, and his figures were allowed to represent them in order to condense the Table.

The specific gravities for percentage under and over proof are partly copied and partly deduced by interpolation from a table of Dr. Ure, given in his Dictionary of Arts, Manufactures, and Mines, Eng. edition of 1860, vol. 1, pp. 57 and 58. This method of stating the percentage under or over proof is that adopted by the British Board of Excise, and it is applied by Sykes's hydrometer. In Dr. Ure's table, however, 0.9200 is given as the specific gravity of proof spirit, while in his text at p. 44 it is given on the authority of Drinkwater as 0.919. This table of Dr. Ure is not copied literally, but his figures are altered to coincide with those of Fownes and Tralles, wherever the values are not affected beyond the limit of error admitted in the design of this Table as above stated.

The specific gravities for percentage of proof spirit are taken from the Manual for Gaugers of Spirits, published by authority of the Treasury Department of the United States in 1870. This is the method of stating strength which is used by the United States Internal Revenue Department; and it is peculiar in introducing a new strength and definition for the term "proof spirit," namely, "that alcoholic liquor which contains one-half its volume of alcohol of a specific gravity of .7939 at 60° Fahrenheit." The specific gravity of such proof spirit is stated to be .93353 at 60° F. Water at its maximum density

being taken as unity. The British legal definition of "proof spirit," describes it as "such as shall, at the temperature of fifty-one degrees of Fahrenheit's thermometer, weigh exactly twelve-thirteenth parts of an equal measure of distilled water." The specific gravity of this "proof spirit" is stated to be .919 at 60° F. This latter is the older and long-accepted proof spirit, and it is probable that few who use the term "proof spirit" in this country know that it has been legally applied to an inferior strength. The old commercial usage of quoting price upon "proof" strength, and increasing or diminishing this by percentage as this spirit is above or below "proof," is the chief argument for this method. This method also introduces a very peculiar use of language in such expressions as "one hundred and eighty per cent." That is, one hundred and eighty to the hundred; the greater included within the less. This Table III of the Government Manual is not copied literally, but is treated in the same manner as that for percentage under and over proof, in making numbers which are of nearly the same value read as though they were in actual coincidence.

The specific gravities given in the second column of the Table, namely, those at 25° C. = 77° F., are deduced by applying to the specific gravities of the first column, the differences for temperature given in a table quoted from Tralles in Watts's Dictionary of Chemistry, vol. 1, p. 88, the deficiencies in the table quoted being supplied by interpolation. Though this column cannot be entirely trustworthy, its range of error is in all probability well within that of ordinary hydrometers, or even specific-gravity bottles; and is within the moderate degree of accuracy claimed for the entire Table.

The seventh column of the Table is the weight in grammes of one gallon of spirit of all the various strengths, at $15\frac{5}{9}$° C. = 60° F. This and all the succeeding columns are given upon the authority of the writer. The laborious calculations involved were made at such intervals as could be taken from an active business. But as they have been re-examined and checked by more competent arithmeticians, it is hoped that they may be free from serious practical errors.

The first step was to ascertain the weight of a gallon of distilled water at $15\frac{5}{9}°$ C. = 60° F. This, which was at first supposed to be only difficult, proved in the end to be impossible, because no U. S. law could be found establishing the standard gallon, and after careful inquiry at Washington, it is believed that no such law is in existence. Various authorities, however, give the value of what they call the U. S. legal gallon, as 231 cubic inches, or 58372.1757 grains of pure water at its maximum density of 39.83° F. As this temperature is not that of the maximum density of water, but rather 3.945° C. = 39.101° F., as determined by Playfair and Joule, there must be a small error from temperature in this determination. It was, however, accepted as the best attainable authority. It next became necessary to get the weight of this gallon at the temperature of $15\frac{5}{9}°$ C. = 60° F. This has been frequently determined and published at different values, varying within a range of ten grains. This was too great a diversity even for the low degree of accuracy aimed at in the design of this Table, and therefore a new determination from more modern data was undertaken. In Poggendorff's Annalen, vol. 72, p. 1 to 223, Kopp has given a more accurate table of the expansion of water by heat than had been before attained. Applying his results to the so-called U. S. legal gallon, the weight of pure water at $15\frac{5}{9}°$ C. = 60° F. (without correction for difference in density or displacement for either weights or air between this temperature and that given as the maximum density of water), is 58319.5714 grains. When this deduced weight of the so-called standard gallon is checked by the new weight of the cubic inch of water, as corrected from the determinations of Captain Kater by Prof. F. A. P. Barnard (see "The Metric System, by F. A. P. Barnard," 1872, p. 167), it is found to be, though not with scientific precision in accordance with this latest good authority, yet sufficiently near for the purposes of this Table. It is, therefore, accepted as being practically correct, although it is from 7 to 10 grains less than the weight given by good authorities. For the use of this Table, 58320 grains is adopted as being true to the nearest grain, and the eighth column of the table, or the

weight of one gallon at $15\frac{5}{9}$° C. = 60° F. in grains, is obtained by multiplying the specific gravities at $15\frac{5}{9}$° C. = 60° F. by 58320, and accepting the nearest grain for the final figure. The seventh column, or the weight of one gallon at $15\frac{5}{9}$° C. = 60° F. in grammes, is obtained by dividing the weight in grains by 15.432, or the value of a gramme in grains.

The ninth, tenth, and eleventh columns, are together equivalent to the eighth column, the grains being here expressed in the commercial avoirdupois weight of pounds, ounces, and grains.

The twelfth and thirteenth columns, taken together, give the avoirdupois pounds and ounces to the nearest ounce.

The thirteenth column gives the weight to the nearest half pound of forty gallons at $15\frac{5}{9}$° C. = 60° F. It is obtained by multiplying the figures of the eighth column by 40, and reducing the grains to pounds.

The fourteenth column is the weight of a pint at $15\frac{5}{9}$° C. = 60° F. in grammes; and the fifteenth is the weight of the same quantity, at the same temperature, in grains. These columns are obtained by dividing the figures of the seventh and eighth columns by 8.

USE OF THE TABLE.

This Table is susceptible of being used for many purposes and in many ways, since any quantity of any column being known, the corresponding quantities in all the other columns may be known by simple inspection. For example, if a spirit be known to contain 52 per cent. of absolute alcohol by weight, by seeking out this number in the column of percentage by weight, it will be found to contain 60 per cent. by volume; or to be 5 per cent. over proof; or to contain 120 per cent. of proof spirit. Its specific gravity at $15\frac{5}{9}$° C. = 60° F. will be 0.9135, or at 25° C. = 77° F. will be 0.9056. The weight of a gallon, at the standard temperature given, will be 3452.24 grammes, or 53275 grains, or 7 lbs. 9 oz. 338 grains, or, practically, 7 lbs. 10 oz. The weight of 40 gallons, at the standard temperature, will be 304.5 lbs., and the weight of one pint will be 431.53 grammes, or 6659 grains.

One of the chief uses of the Table, however, is to verify or control the uncertain and difficult process of measuring by volume by the more easy and accurate process of measuring by weight; and of determining the true proportion of absolute alcohol by weight. In order to use it for such purposes, an hydrometer and jar, and a thermometer, are necessary. Let a sample be taken from the barrel by means of a thief, or a small rubber-tubing siphon into the hydrometer jar. Then, if the hydrometer be—as it should be—one with a specific-gravity scale, and adjusted for 15⅝° C. = 60° F., the sample may be either cooled down to this temperature, or, what is much more convenient and easy, be warmed up by the warmth of the hand to 25° C. = 77° F. This adjustment of the temperature is greatly accelerated by stirring the liquid with the long tubular thermometer, and the hand that warms the glass should grasp it round the lower part of the cylinder. If the hydrometer to be used indicates, instead of specific gravities, simply percentage by weight, or percentage by volume, or percentage over and under proof, or percentage of proof spirit, then the temperature must be adjusted to that given on the stem of the instrument. The hydrometer is then placed in the liquid and carefully read. That column of the table to which the hydrometer belongs is then sought, and when the figure which corresponds to the reading is found, all the required data will be found upon the same line.

For example: Suppose the spirit from a barrel, when warmed up to 25° C. = 77° F., be found to have, by the second column, an apparent sp. gr. of 0.9056, then its true sp. gr. would be 0.9135, it would contain 52 per cent. by weight, or 60 per cent. by volume of absolute alcohol, would be 5 per cent. over proof, or would contain 120 per cent. of U. S. proof spirit. A gallon of it at standard temperature would weigh 3452.24 grammes, or 53275 grains, or 7 lbs. 9 oz. 338 grains, or practically 7 lbs. 10 oz.; and 40 gallons of it would weigh 304½ lbs. Now suppose the barrel to weigh 389 lbs. gross, and to have a marked or ascertained tare of 61 lbs., giving a net weight of 328 lbs. of spirit. Then the weight of 40 gallons, namely, 304½ lbs., subtracted from this would leave a remainder of 23½ lbs., which

is 10 oz. more than three times the weight of a single gallon of 7 lbs. 10 oz. Therefore, the barrel would contain practically 43 gallons and about ⅔ pint, this latter fraction being disregarded. And this would be the actual precise measure at the standard temperature, no matter at what temperature the spirit might be when weighed. If several or many barrels had to be measured or verified, and the tares of the barrels not known, it would only be necessary to start with one empty barrel, and then pass the spirit by a siphon or pump from one barrel to another until all the tares were obtained. With an established custom of using barrels with marked tares, the verification would of course be much more simple and easy. Even if every package has to be emptied to obtain the tares, the verification by weight is far quicker, and far less wasteful, as well as more accurate, than by measuring, thus saving much time, and expense, and loss, in cases of disputed gauging in the spirit market.

If the hydrometer in use indicates strength by any of the scales given in the Table other than by specific gravity, and the sample be cooled to the temperature given on the instrument, it is of course used in the same way by looking for its indication in its appropriate column.

The consumer who buys his alcohol or spirit in smaller quantities, can still more easily verify his purchases by the use of tared vessels. And when the time comes that the absolute alcohol in any spirit shall be sold by the pound, the whole matter of control will be very plain and simple, and all true interests be best subserved.

In the use of the Table by the pharmacist to control the results of repercolation for making fluid extracts, the weight of the pint of menstruum of all strengths will be found very useful. It will also be useful to those who have substituted weights for measures in the use of alcoholic liquids in making tinctures, &c.

BROOKLYN, September, 1873.

TABLE FOR DISTILLED SPIRITS AND ALCOHOL.

PART I.—From 0 to 10 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at $15\frac{5}{9}$° C.—60° F. taken as unity.)		Percentage.				Weight of one gallon, at $15\frac{5}{9}$° C.—60° F.							Weight of 40 gallons to the nearest half pound, at $15\frac{5}{9}$° C.—60° F	Weight of one pint, at $15\frac{5}{9}$° C.—60° F.	
								Avoirdupois Weig't.							
						In Grammes.	In Grains.	lbs	ozs	Grs.	To the nearest ounce.			In Grms.	In Grs.
											lbs.	ozs	lbs.		
At $15\frac{5}{9}$° C. —60° F.	At 25° C.—77° F.	By weight.	By volume.	Under proof. (Brit. Excise.)	Of proof spirit. (U.S. Revenue.)										
1.0000	0.9986					3779.13	58,320	8	5	132	8	5	333.5	472.39	7290
0.9993	0.9978			99	1	3776.50	58,279	8	5	91	8	5	333.0	472.06	7285
0.9985	0.9970		1	98	2	3773.46	58,232	8	5	44	8	5	332.5	471.68	7279
0.9981	0.9966	1				3771.97	58,209	8	5	22	8	5	332.5	471.49	7276
0.9976	0.9961			97	3	3770.08	58,180	8	4	430	8	5	332.5	471.26	7272
0.9970	0.9953		2		4	3767.82	58,145	8	4	395	8	5	332.0	470.98	7268
0.9968	0.9951			96		3767.04	58,133	8	4	383	8	5	332.0	470.88	7267
0.9965	0.9948	2			5	3765.94	58,116	8	4	366	8	5	332.0	470.74	7264
0.9960	0.9943			95		3764.06	58,087	8	4	337	8	5	332.0	470.51	7261
0.9956	0.9938		3		6	3762.51	58,063	8	4	313	8	5	332.0	470.31	7258
0.9952	0.9934			94		3761.02	58,040	8	4	290	8	5	331.5	470.13	7255
0.9947	0.9927	3			7	3759.14	58,011	8	4	261	8	5	331.5	469.89	7251
0.9944	0.9924			93		3757.97	57,993	8	4	243	8	5	331.5	469.75	7249
0.9942	0.9922		4		8	3757.26	57,982	8	4	232	8	5	331.5	469.66	7248
0.9936	0.9916			92	9	3754.99	57,947	8	4	197	8	4	331.0	469.37	7243
0.9930	0.9909	4	5	91	10	3752.72	57,912	8	4	162	8	4	331.0	469.09	7239
0.9921	0.9900			90	11	3749.29	57,859	8	4	109	8	4	330.5	468.66	7232
0.9914	0.9893	5	6	89	12	3746.63	57,818	8	4	68	8	4	330.5	468.33	7227
0.9906	0.9885			88	13	3743.65	57,772	8	4	22	8	4	330.0	467.95	7221
0.9900	0.9879			87		3741.38	57,737	8	3	424	8	4	330.0	467.67	7217
0.9898	0.9876	6	7		14	3740.60	57,725	8	3	413	8	4	330.0	467.58	7216
0.9892	0.9870			86	15	3738.33	57,690	8	3	377	8	4	329.5	467.29	7211
0.9890	0.9868		8		16	3737.56	57,678	8	3	366	8	4	329.5	467.19	7210
0.9885	0.9863			85		3735.68	57,649	8	3	336	8	4	329.5	466.96	7206
0.9884	0.9862	7			17	3735.29	57,643	8	3	331	8	4	329.5	466.91	7205
0.9878	0.9855		9	84	18	3733.02	57,608	8	3	296	8	4	329.0	466.63	7201
0.9872	0.9849			83	19	3730.82	57,574	8	3	261	8	4	329.0	466.35	7197
0.9869	0.9846	8	10		20	3729.65	57,556	8	3	243	8	4	329.0	466.21	7194
0.9864	0.9841			82	21	3727.77	57,527	8	3	214	8	3	328.5	465.97	7191
0.9857	0.9834			81		3725.12	57,486	8	3	173	8	3	328.5	465.64	7186
0.9855	0.9831	9	11		22	3724.34	57,474	8	3	161	8	3	328.5	465.54	7184
0.9852	0.9828			80	23	3723.24	57,457	8	3	144	8	3	328.5	465.40	7182
0.9845	0.9821			79		3720.58	57,416	8	3	103	8	3	328.0	465.07	7177
0.9841	0.9816	10	12		24	3719.09	57,393	8	3	81	8	3	328.0	464.89	7174

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART II.—From 10 to 25 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.							Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint, at 15⅝° C.=60° F.	
						In Grammes.	In Grains.	Avoirdupois Weig't.							
								lbs	ozs	Grs.	To the nearest ounce.				
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)						lbs	ozs	lbs.	In Grms.	In Grs.
0.9838	0.9813			78	25	3717.92	57,375	8	3	62	8	3	328.0	464.74	7172
0.9831	0.9806			77	26	3715.27	57,334	8	3	21	8	3	327.5	464.41	7167
0.9828	0.9801	11	13		27	3714.17	57,317	8	3	5	8	3	327.5	464.27	7165
0.9825	0.9798			76		3713.00	57,299	8	2	424	8	3	327.5	464.13	7162
0.9821	0.9793		14		28	3711.51	57,276	8	2	401	8	3	327.5	463.94	7159
0.9819	0.9791			75		3710.73	57,264	8	2	389	8	3	327.0	463.84	7158
0.9815	0.9787	12	15		29	3709.24	57,241	8	2	366	8	3	327.0	463.65	7155
0.9813	0.9785			74	30	3708.46	57,229	8	2	354	8	3	327.0	463.56	7154
0.9807	0.9779			73	31	3706.19	57,194	8	2	319	8	3	327.0	463.27	7149
0.9802	0.9773	13	16	72	32	3704.32	57,165	8	2	290	8	3	326.5	463.04	7146
0.9794	0.9765			71	33	3701.33	57,119	8	2	244	8	3	326.5	462.67	7140
0.9789	0.9759	14	17	70	34	3699.33	57,089	8	2	214	8	2	326.0	462.42	7136
0.9784	0.9754			69	35	3697.51	57,060	8	2	185	8	2	326.0	462.19	7132
0.9778	0.9746	15	18	68	36	3695.24	57,025	8	2	150	8	2	326.0	461.90	7128
0.9775	0.9743				37	3694.14	57,008	8	2	123	8	2	326.0	461.77	7126
0.9772	0.9740			67	38	3692.97	56,990	8	2	115	8	2	325.5	461.62	7124
0.9766	0.9733	16	19	66	39	3690.71	56,955	8	2	80	8	2	325.5	461.34	7119
0.9760	0.9726		20	65	40	3688.44	56,920	8	2	45	8	2	325.5	461.05	7115
0.9753	0.9719	17	21	64	41	3685.78	56,879	8	2	4	8	2	325.0	460.72	7110
0.9749	0.9715			63	42	3684.29	56,856	8	1	418	8	2	325.0	460.54	7107
0.9743	0.9709			62	43	3682.02	56,821	8	1	383	8	2	324.5	460.25	7103
0.9741	0.9706	18	22		44	3681.31	56,810	8	1	373	8	2	324.5	460.16	7101
0.9737	0.9702			61	45	3679.76	56,786	8	1	348	8	2	324.5	459.97	7098
0.9732	0.9697			60	46	3677.88	56,757	8	1	319	8	2	324.5	459.73	7095
0.9728	0.9692	19	23	59	47	3676.39	56,734	8	1	297	8	2	324.0	459.55	7092
0.9720	0.9684			58	48	3673.27	56,687	8	1	249	8	2	324.0	459.16	7086
0.9716	0.9678	20	24		49	3671.85	56,664	8	1	227	8	2	324.0	458.98	7083
0.9714	0.9676			57	50	3671.07	56,652	8	1	214	8	1	323.5	458.88	7081
0.9709	0.9668		25	56		3669.19	56,623	8	1	186	8	1	323.5	458.65	7078
0.9704	0.9661	21		55	51	3667.31	56,594	8	1	157	8	1	323.5	458.41	7074
0.9698	0.9655		26	54	52	3665.05	56,559	8	1	122	8	1	323.0	458.13	7070
0.9693	0.9650				53	3663.17	56,530	8	1	92	8	1	323.0	457.90	7066
0.9691	0.9646	22	27	53	54	3662.39	56,518	8	1	81	8	1	323.0	457.80	7065
0.9683	0.9638			52	55	3659.36	56,471	8	1	33	8	1	322.5	457.42	7059
0.9678	0.9631	23	28	51	56	3657.47	56,442	8	1	5	8	1	322.5	457.18	7055
0.9671	0.9624			50	57	3654.81	56,401	8	0	401	8	1	322.5	456.85	7050
0.9665	0.9617	24	29	49	58	3652.54	56,366	8	0	366	8	1	322.0	456.57	7046
0.9658	0.9610			48	59	3649.88	56,325	8	0	325	8	1	322.0	456.24	7041
0.9652	0.9603	25	30	47	60	3647.62	56,290	8	0	290	8	1	321.5	455.95	7036

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART III.—From 25 to 40 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15 5/9° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15 5/9° C.=60° F.							Weight of 40 gallons to the nearest half pound, at 15 5/9° C.=60° F	Weight of one pint at 15 5/9° C.=60° F.	
								Avoirdupois Weig't.							
											To the nearest ounce.				
At 15 5/9° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.9645	0.9597			46	61	3645.02	56,250	8	0	250	8	1	321.5	455.63	7031
0.9643	0.9594		31		62	3644.24	56,238	8	0	238	8	1	321.5	455.53	7030
0.9638	0.9590	26		45	63	3642.37	56,209	8	0	209	8	0	321.0	455.30	7026
0.9631	0.9582		32	44	64	3639.71	56,168	8	0	168	8	0	321.0	454.96	7021
0.9623	0.9574	27		43	65	3636.66	56,121	8	0	121	8	0	320.5	454.58	7015
0.9618	0.9567		33	42	66	3634.79	56,092	8	0	92	8	0	320.5	454.35	7011
0.9609	0.9556	28	34	41	67	3631.42	56,040	8	0	40	8	0	320.0	453.93	7005
0.9602	0.9549			40	68	3628.76	55,999	7	15	436	8	0	320.0	453.59	7000
0.9595	0.9542			39	69	3626.10	55,958	7	15	395	8	0	320.0	453.26	6995
0.9593	0.9538	29	35		70	3625.33	55,946	7	15	383	8	0	319.5	453.17	6993
0.9587	0.9532			38	71	3623.06	55,911	7	15	348	8	0	319.5	452.88	6989
0.9578	0.9521	30	36	37	72	3619.69	55,859	7	15	296	8	0	319.0	452.46	6982
0.9572	0.9515			36	73	3617.42	55,824	7	15	261	8	0	319.0	452.18	6978
0.9565	0.9507		37	35		3614.76	55,783	7	15	220	8	0	319.0	451.84	6973
0.9560	0.9500	31			74	3612.88	55,754	7	15	191	7	15	318.5	451.61	6969
0.9555	0.9495			34	75	3611.03	55,725	7	15	162	7	15	318.5	451.38	6966
0.9550	0.9489		38	33	76	3609.12	55,696	7	15	133	7	15	318.0	451.14	6962
0.9544	0.9482	32			77	3606.86	55,661	7	15	98	7	15	318.0	450.86	6958
0.9539	0.9577			32		3604.91	55,631	7	15	68	7	15	318.0	450.61	6954
0.9535	0.9473		39		78	3603.42	55,608	7	15	45	7	15	318.0	450.43	6951
0.9528	0.9465	33		31	79	3600.76	55,567	7	15	4	7	15	317.5	450.09	6946
0.9519	0.9456		40	30	80	3597.39	55,515	7	14	390	7	15	317.0	449.67	6939
0.9511	0.9446	34		29	81	3594.35	55,468	7	14	343	7	15	317.0	449.29	6933
0.9503	0.9438		41	28	82	3591.30	55,421	7	14	296	7	15	316.5	448.91	6928
0.9495	0.9430			27	83	3588.32	55,375	7	14	250	7	15	316.5	448.54	6922
0.9490	0.9424	35	42		84	3586.44	55,346	7	14	221	7	15	316.0	448.30	6918
0.9485	0.9419			26		3584.56	55,317	7	14	192	7	14	316.0	448.07	6915
0.9475	0.9409			25	85	3580.74	55,258	7	14	133	7	14	316.0	447.59	6907
0.9470	0.9402	36	43		86	3578.86	55,229	7	14	104	7	14	315.5	447.36	6904
0.9465	0.9397			24		3576.98	55,200	7	14	75	7	14	315.5	447.12	6900
0.9455	0.9387			23	87	3573.22	55,142	7	14	17	7	14	315.0	446.65	6893
0.9452	0.9382	37	44		88	3572.06	55,124	7	13	437	7	14	315.0	446.51	6890
0.9446	0.9376			22	89	3569.79	55,089	7	13	401	7	14	315.0	446.22	6886
0.9434	0.9363	38	45	21	90	3565.25	55,019	7	13	331	7	14	314.5	445.66	6877
0.9426	0.9355			20	91	3562.21	54,972	7	13	284	7	14	314.0	445.28	6871
0.9416	0.9343	39	46	19	92	3558.45	54,914	7	13	226	7	14	314.0	444.81	6864
0.9405	0.9332			18	93	3554.30	54,850	7	13	162	7	13	313.5	444.29	6856
0.9396	0.9323	40	47	17	94	3550.87	54,797	7	13	109	7	13	313.0	443.86	6850
0.9391	0.9318				95	3548.99	54,768	7	13	75	7	13	313.0	443.62	6846

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART IV.—From 40 to 55 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint, at 15⅝° C.=60° F.	
								Avoirdupois Weig't.						
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	To the nearest ounce. lbs	To the nearest ounce. ozs	lbs	In Grms.	In Grs.
0.9381	0.9307		48	16	96	3545.23	54,710	7	13	22	7	13	312.5	443.15	6839
0.9376	0.9302	41				3543.35	54,681	7	12	431	7	13	312.5	442.92	6835
0.9373	0.9300			15	97	3542.19	54,663	7	12	413	7	13	312.5	442.77	6833
0.9362	0.9288		49	14	98	3538.04	54,599	7	12	349	7	13	312.0	442.25	6825
0.9356	0.9280	42				3535.77	54,564	7	12	314	7	13	312.0	441.97	6820
0.9352	0.9276			13	99	3534.28	54,541	7	12	291	7	13	311.5	441.78	6818
0.9343	0.9267		50	12	100	3530.84	54,488	7	12	238	7	13	311.5	441.35	6811
0.9335	0.9259	43			101	3527.86	54,442	7	12	192	7	12	311.0	440.98	6805
0.9329	0.9253			11		3525.59	54,407	7	12	157	7	12	311.0	440.70	6801
0.9323	0.9246		51		102	3523.33	54,372	7	12	122	7	12	310.5	440.42	6796
0.9318	0.9242			10		3521.45	54,343	7	12	93	7	12	310.5	440.18	6793
0.9314	0.9237	44			103	3519.89	54,319	7	12	69	7	12	310.5	439.99	6790
0.9306	0.9230			9		3516.91	54,273	7	12	23	7	12	310.0	439.61	6784
0.9303	0.9226		52		104	3515.75	54,255	7	12	5	7	12	310.0	439.47	6782
0.9292	0.9214	45		8	105	3511.59	54,191	7	11	379	7	12	309.5	438.95	6774
0.9283	0.9205		53	7	106	3508.16	54,138	7	11	326	7	12	309.5	438.52	6767
0.9270	0.9192	46		6	107	3503.30	54,063	7	11	251	7	12	309.0	437.91	6758
0.9262	0.9184		54	5	108	3500.26	54,016	7	11	204	7	11	308.5	437.53	6752
0.9249	0.9171	47		4	109	3495.33	53,940	7	11	128	7	11	308.0	436.92	6742
0.9242	0.9164		55		110	3492.68	53,899	7	11	87	7	11	308.0	436.58	6737
0.9236	0.9158			3		3490.41	53,864	7	11	51	7	11	308.0	436.30	6733
0.9228	0.9150	48			111	3487.43	53,818	7	11	6	7	11	307.5	435.93	6727
0.9221	0.9143		56	2	112	3484.77	53,777	7	10	402	7	11	307.5	435.60	6722
0.9212	0.9134			1	113	3481.34	53,724	7	10	349	7	11	307.0	435.17	6715
0.9206	0.9128	49				3479.07	53,689	7	10	314	7	11	307.0	434.88	6711
0.9200	0.9122		57	Proof over.	114	3476.80	53,654	7	10	279	7	11	306.5	434.60	6707
0.9189	0.9111			1	115	3472.65	53,590	7	10	215	7	10	306.0	434.08	6699
0.9184	0.9106	50				3470.77	53,561	7	10	186	7	10	306.0	433.85	6695
0.9178	0.9100		58	2	116	3468.51	53,526	7	10	151	7	10	306.0	433.56	6691
0.9168	0.9090				117	3464.75	53,468	7	10	93	7	10	305.5	433.09	6684
0.9160	0.9081	51	59	3	118	3461.70	53,421	7	10	46	7	10	305.0	432.71	6678
0.9150	0.9071			4	119	3457.94	53,363	7	9	425	7	10	305.0	432.24	6670
0.9135	0.9056	52	60	5	120	3452.24	53,275	7	9	338	7	10	304.5	431.53	6659
0.9124	0.9045			6	121	3448.09	53,211	7	9	273	7	10	304.0	431.01	6651
0.9113	0.9034	53	61	7	122	3443.95	53,147	7	9	210	7	9	303.5	430.49	6643
0.9100	0.9021			8	123	3439.02	53,071	7	9	133	7	9	303.0	429.88	6634
0.9090	0.9011	54	62	9	124	3435.26	53,013	7	9	76	7	9	303.0	429.41	6627
0.9075	0.8995			10	125	3429.56	52,925	7	8	425	7	9	302.5	428.69	6616
0.9069	0.8989	55	63		126	3427.29	52,890	7	8	390	7	9	302.0	428.41	6611

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART V.—From 55 to 70 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.—60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.—60° F.							Weight of 40 gallons to the nearest half pound, at 15⅝° C.—60° F	Weight of one pint, at 15⅝° C.—60° F.	
								Avoirdupois Weig't.							
											To the nearest ounce.				
At 15⅝° C. —60° F.	At 25° C.— 77° F.	By weight.	By volume.	Over proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.9062	0.8982			11	127	3424.70	52,850	7	8	350	7	9	302.0	428.09	6606
0.9047	0.8969	56	64	12	128	3419.00	52,762	7	8	262	7	9	301.5	427.37	6595
0.9036	0.8958			13		3414.85	52,698	7	8	198	7	8	301.0	426.86	6587
0.9025	0.8947	57	65		129	3410.70	52,634	7	8	134	7	8	301.0	426.34	6579
0.9021	0.8943			14	130	3409.15	52,610	7	8	110	7	8	300.5	426.14	6576
0.9008	0.8930			15	131	3404.29	52,535	7	8	35	7	8	300.0	425.54	6567
0.9001	0.8923	58	66		132	3401.63	52,494	7	7	432	7	8	300.0	425.20	6562
0.8994	0.8916			16	133	3398.98	52,453	7	7	390	7	8	299.5	424.87	6557
0.8979	0.8901	59		17		3393.34	52,366	7	7	304	7	8	299.0	424.17	6546
0.8973	0.8895		67		134	3391.07	52,331	7	7	269	7	8	299.0	423.88	6541
0.8966	0.8888			18		3388.41	52,290	7	7	227	7	8	299.0	423.55	6536
0.8956	0.8878	60			135	3384.59	52,231	7	7	169	7	7	298.5	423.07	6529
0.8953	0.8875			19		3383.49	52,214	7	7	151	7	7	298.5	422.94	6527
0.8949	0.8870		68		136	3382.00	52,191	7	7	129	7	7	298.0	422.75	6524
0.8938	0.8859			20	137	3377.79	52,126	7	7	63	7	7	298.0	422.22	6516
0.8932	0.8853	61				3375.52	52,091	7	7	29	7	7	297.5	421.94	6511
0.8925	0.8846		69	21	138	3372.93	52,051	7	6	426	7	7	297.5	421.62	6506
0.8910	0.8831			22	139	3367.22	51,963	7	6	338	7	7	297.0	420.90	6495
0.8908	0.8829	62				3366.45	51,951	7	6	326	7	7	297.0	420.81	6494
0.8900	0.8821		70		140	3363.47	51,905	7	6	280	7	7	296.5	420.43	6488
0.8897	0.8818			23		3362.30	51,887	7	6	262	7	7	296.5	420.29	6486
0.8886	0.8807	63			141	3358.15	51,823	7	6	198	7	6	296.0	419.77	6478
0.8883	0.8804			24		3357.05	51,806	7	6	181	7	6	296.0	419.63	6476
0.8875	0.8796		71		142	3354.00	51,759	7	6	134	7	6	296.0	419.25	6470
0.8869	0.8790			25		3351.74	51,724	7	6	99	7	6	295.5	418.97	6465
0.8863	0.8784	64			143	3349.47	51,689	7	6	64	7	6	295.5	418.68	6461
0.8854	0.8775			26		3346.10	51,637	7	6	12	7	6	295.0	418.26	6455
0.8850	0.8771		72		144	3344.54	51,613	7	5	426	7	6	295.0	418.07	6452
0.8840	0.8761	65		27	145	3340.78	51,555	7	5	368	7	6	294.5	417.60	6444
0.8825	0.8746		73	28	146	3335.08	51,467	7	5	279	7	6	294.0	416.88	6433
0.8816	0.8736	66				3331.71	51,415	7	5	228	7	6	294.0	416.46	6427
0.8811	0.8731			29	147	3329.83	51,386	7	5	198	7	5	293.5	416.23	6423
0.8799	0.8719		74	30	148	3325.30	51,316	7	5	129	7	5	293.0	415.66	6414
0.8793	0.8713	67			149	3323.03	51,281	7	5	94	7	5	293.0	415.38	6410
0.8783	0.8703			31		3319.21	51,222	7	5	34	7	5	292.5	414.90	6403
0.8769	0.8689	68	75	32	150	3313.96	51,141	7	4	391	7	5	292.0	414.25	6393
0.8754	0.8674			33	151	3308.25	51,053	7	4	303	7	5	291.5	413.53	6382
0.8745	0.8665	69	76		152	3304.89	51,001	7	4	251	7	5	291.5	413.11	6375
0.8739	0.8659			34	153	3302.62	50,966	7	4	216	7	4	291.0	412.83	6371
0.8721	0.8641	70	77	35	154	3295.81	50,861	7	4	111	7	4	290.5	411.98	6358

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART VI.—From 70 to 85 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60°F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60°F	Weight of one pint at 15⅝° C.=60° F.	
								Avoirdupois Weig't.						
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Over proof. (British Excise.)	Of proof spirit. (U.S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	To the nearest ounce. lbs	ozs	lbs.	In Grms.	In Grs.
0.8708	0.8628			36	155	3290.89	50,785	7	4	35	7	4	290.0	411.36	6348
0.8696	0.8616	71	78	37		3286.35	50,715	7	3	403	7	4	290.0	410.79	6339
0.8693	0.8613				156	3285.25	50,698	7	3	385	7	4	289.5	410.66	6337
0.8678	0.8598			38	157	3279.55	50,610	7	3	297	7	4	289.0	409.94	6326
0.8672	0.8591	72			158	3277.28	50,575	7	3	263	7	4	289.0	409.66	6322
0.8664	0.8583		79	39		3274.23	50,528	7	3	216	7	3	288.5	409.28	6316
0.8649	0.8568	73			159	3268.59	50,441	7	3	129	7	3	288.0	408.57	6305
0.8646	0.8565			40		3267.43	50,423	7	3	110	7	3	288.0	408.43	6303
0.8639	0.8558		80		160	3264.84	50,383	7	3	71	7	3	288.0	408.10	6298
0.8631	0.8550			41		3261.79	50,336	7	3	23	7	3	287.5	407.72	6292
0.8625	0.8544	74				3259.53	50,301	7	2	426	7	3	287.5	407.44	6288
0.8615	0.8534			42	161	3255.77	50,243	7	2	368	7	3	287.0	406.97	6280
0.8611	0.8530		81		162	3254.21	50,219	7	2	344	7	3	287.0	406.78	6277
0.8603	0.8522	75			163	3251.23	50,173	7	2	298	7	3	286.5	406.40	6272
0.8599	0.8518			43		3249.68	50,149	7	2	274	7	3	286.5	406.21	6269
0.8581	0.8500	76	82	44	164	3242.87	50,044	7	2	169	7	2	286.0	405.36	6255
0.8566	0.8485			45	165	3237.23	49,957	7	2	82	7	2	285.5	404.65	6245
0.8557	0.8476	77	83			3233.80	49,904	7	2	29	7	2	285.0	404.22	6238
0.8550	0.8469			46	166	3231.21	49,864	7	1	426	7	2	285.0	403.90	6233
0.8539	0.8458				167	3227.00	49,799	7	1	361	7	2	284.5	403.38	6225
0.8533	0.8452	78		47		3224.73	49,764	7	1	327	7	2	284.5	403.09	6220
0.8526	0.8444		84		168	3222.14	49,724	7	1	287	7	2	284.0	402.77	6215
0.8516	0.8434			48		3218.31	49,665	7	1	227	7	2	284.0	402.29	6208
0.8508	0.8426	79			169	3215.33	49,619	7	1	182	7	1	283.5	401.92	6202
0.8501	0.8419			49	170	3212.67	49,578	7	1	140	7	1	283.5	401.58	6197
0.8496	0.8414		85			3210.79	49,549	7	1	112	7	1	283.0	401.35	6194
0.8483	0.8401	80		50	171	3205.87	49,473	7	1	36	7	1	282.5	400.73	6184
0.8466	0.8384		86	51	172	3199.46	49,374	7	0	374	7	1	282.0	399.93	6172
0.8459	0.8377	81				3196.80	49,333	7	0	333	7	1	282.0	399.60	6167
0.8450	0.8368			52	173	3193.36	49,280	7	0	280	7	1	281.5	399.17	6160
0.8434	0.8352	82	87	53	174	3187.34	49,187	7	0	187	7	0	281.0	398.42	6148
0.8415	0.8333			54	175	3180.15	49,076	7	0	76	7	0	280.5	397.52	6134
0.8408	0.8326	83	88			3177.49	49,035	7	0	35	7	0	280.0	397.19	6129
0.8396	0.8314			55	176	3172.95	48,965	6	15	402	7	0	280.0	396.62	6121
0.8387	0.8305				177	3169.58	48,913	6	15	350	7	0	279.5	396.20	6114
0.8382	0.8300	84				3167.70	48,884	6	15	322	7	0	279.5	395.96	6110
0.8376	0.8294			56		3165.44	48,849	6	15	286	7	0	279.0	395.68	6106
0.8373	0.8291		89		178	3164.27	48,831	6	15	269	7	0	279.0	395.53	6104

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART VII.—From 85 to 100 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F. lbs.	Weight of one pint, at 15⅝° C.=60° F.	
								Avoirdupois Weig't.						
											To the nearest ounce.			
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Over proof. British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs		In Grms.	In Grs.
0.8357	0.8275	85		57	179	3158.24	48,738	6	15	176	6	15	278.5	394.78	6092
0.8340	0.8258		90		180	3151.83	48,639	6	15	77	6	15	278.0	393.98	6080
0.8336	0.8254			58		3150.34	48,616	6	15	53	6	15	278.0	393.79	6077
0.8331	0.8249	86				3148.39	48,586	6	15	24	6	15	277.5	393.55	6073
0.8317	0.8235			59	181	3143.14	48,505	6	14	380	6	15	277.0	392.89	6063
0.8305	0.8223	87	91		182	3138.61	48,435	6	14	310	6	15	277.0	392.33	6054
0.8298	0.8216			60		3135.95	48,394	6	14	269	6	15	276.5	391.99	6049
0.8288	0.8206				183	3132.19	48,336	6	14	211	6	14	276.0	391.52	6042
0.8279	0.8197	88		61		3128.76	48,283	6	14	158	6	14	276.0	391.09	6035
0.8272	0.8191		92		184	3126.10	48,242	6	14	117	6	14	275.5	390.76	6030
0.8259	0.8178			62		3121.15	48,166	6	14	41	6	14	275.0	390.14	6021
0.8254	0.8173	89			185	3119.30	48,137	6	14	12	6	14	275.0	389.91	6017
0.8240	0.8159			63		3114.05	48,056	6	13	368	6	14	274.5	389.26	6007
0.8237	0.8156		93		186	3112.88	48,038	6	13	351	6	14	274.5	389.11	6005
0.8228	0.8147	90				3109.51	47,986	6	13	299	6	14	274.0	388.69	5998
0.8221	0.8140			64	187	3106.86	47,945	6	13	257	6	14	274.0	388.36	5993
0.8199	0.8118	91	94	65	188	3098.56	47,817	6	13	130	6	13	273.0	387.32	5977
0.8176	0.8095			66	189	3089.81	47,682	6	12	432	6	13	272.5	386.23	5960
0.8172	0.8091	92				3088.32	47,659	6	12	409	6	13	272.5	386.04	5957
0.8164	0.8083		95		190	3085.28	47,612	6	12	362	6	13	272.0	385.66	5951
0.8156	0.8075			67		3082.30	47,566	6	12	316	6	13	272.0	385.29	5946
0.8145	0.8064	93				3078.15	47,502	6	12	252	6	13	271.5	384.77	5938
0.8139	0.8058				191	3075.88	47,467	6	12	217	6	12	271.0	384.48	5933
0.8134	0.8053			68		3073.94	47,437	6	12	187	6	12	271.0	384.24	5930
0.8125	0.8044		96			3070.57	47,385	6	12	135	6	12	271.0	383.82	5923
0.8118	0.8037	94			192	3067.91	47,344	6	12	94	6	12	270.5	383.49	5918
0.8112	0.8031			69		3065.64	47,309	6	12	59	6	12	270.5	383.20	5914
0.8098	0.8017				193	3060.39	47,228	6	11	415	6	12	270.0	382.55	5903
0.8090	0.8009			70		3057.35	47,181	6	11	368	6	12	269.5	382.17	5898
0.8089	0.8008	95				3056.96	47,175	6	11	363	6	12	269.5	382.12	5897
0.8084	0.8003		97		194	3055.08	47,146	6	11	334	6	12	269.5	381.88	5893
0.8061	0.7980	96			195	3046.33	47,011	6	11	200	6	11	268.5	380.79	5876
0.8041	0.7960		98		196	3038.82	46,895	6	11	83	6	11	268.0	379.85	5862
0.8031	0.7950	97				3035.06	46,837	6	11	25	6	11	267.5	379.38	5855
0.8014	0.7933				197	3028.64	46,738	6	10	363	6	11	267.0	378.58	5842
0.8001	0.7920	98				3023.72	46,662	6	10	287	6	11	266.5	377.96	5833
0.7995	0.7914		99			3021.45	46,627	6	10	252	6	11	266.5	377.68	5828
0.7992	0.7911				198	3020.28	46,609	6	10	234	6	11	266.5	377.53	5826
0.7969	0.7888	99			199	3011.59	46,475	6	10	100	6	10	265.5	376.45	5809
0.7946	0.7865		100		200	3002.92	46,341	6	9	404	6	10	265.0	375.37	5793
0.7938	0.7858	100				2999.87	46,294	6	9	357	6	10	264.5	374.98	5787

NOTE ON A GENERAL APPARATUS STAND, UPRIGHT CONDENSER, PINCHCOCK, AND BURETTE STAND,

FOR CHEMICAL AND PHARMACEUTICAL USES.

WITH ILLUSTRATIONS.

THE common piece of apparatus, consisting of an upright rod with sliding rings supported on a broad foot, and generally miscalled a "retort stand," is, as generally met with, an unsatisfactory article, and quite behind the necessities of the present time, yet most persons, like the writer, have continued to get along as well as they could with it rather than spend the time and money necessary to try to improve and extend it. The most prominent defects are weakness and flimsiness, and too narrow a sphere of usefulness for the present wants in table operations. The common use of illuminating gas, and the various modifications of the admirable Bunsen burner, have so increased the number and facility of table operations in chemistry and pharmacy, that a better and more generally useful apparatus stand has been much needed; and this must be the writer's apology for the present attempt to supply this want. To save the reader from lengthy descriptions, and to save the Association the expense of illustrations, the writer has had four woodcuts made, which are presented with this paper, showing some of the more prominent applications of the stand as at present constructed, the stand itself being also presented herewith. As will be seen at a glance, it is a large, rough, uncouth-looking affair; and to those so long used to the light, slender, and bright-looking stands in common use, it will appear exceedingly ugly, clumsy, and unwieldy. But it will be found to give effective and steady support to whatever may be properly placed upon it, and the variety of uses to which it can be conveniently applied is large, and cannot be appreciated at a glance.

It consists of eight principal parts, and several secondary or minor pieces.

First. A cast-iron foot, *A*, 9 by 15 inches, into which a piece of wrought-iron pipe 30 inches long and $\frac{3}{4}$ inch external diameter is firmly screwed upright. This supporting rod or pipe is placed near the middle of the foot, so that several pieces of apparatus, representing as many distinct operations, can be supported all around the rod at the same time.

Second. A circular, round-bottomed sand-bath, *B*, with a horizontal flange around the brim. This flange is perforated and notched for receiving the wires or strings used to support, or tie firmly in, the flasks, retorts, or other vessels which require to be firmly held in the bath. Fine copper wire is best adapted to such purposes, and its use is illustrated in supporting the flask, *a*, Figure 1. This bath is six inches in diameter, but from being a small portion of a large sphere, it is well adapted to a great variety of sizes in vessels.

Third. Two adjustable rings of cast-iron, *C*, about 6 inches in diameter, furnished with three movable rods which slide to or from the centre through holes made in the rings at equal distances apart. These rods are square, and are fixed in any desired position by thumb-screws, and their direction is somewhat oblique to the horizontal plane of the rings, to adapt them to a greater variety of uses, as the rings may be put upon the rod with the thumb-screws either down or up. Figs. 1 and 2, *C*, give illustrations of their use in both positions. By the use of these square rods as radii in the rings, the rings may be adjusted to hold vessels of any size or form, regular or irregular, and in various ways, from the smallest crucible up to a gallon capsule, as may be seen in the figures. This means for adjustment avoids the necessity for rings of various sizes, and is more conveniently and more accurately applicable. The most difficult piece of apparatus to support is the now little-used retort. But if the bottom of a retort of any ordinary size be supported in the round sand-bath, and the body, well up towards the tubulure, be steadied by adjusting the ends of these radiating rods to its irregular form, it may be kept in position with moderate facility. These rings are attached to the upright supporting rod of the stand at any part of its length, so as to be put on or off at any time,

by a device which is believed to be simple and strong, and perhaps not more inconvenient than others at present in use. This device is best seen in detail in Fig. 4, *C*, where *q* is a V-shaped jaw, which when in use touches the upright rod upon only two lines of its circumference. These jaws are skilfully notched or slotted out so as to receive the saddle *r*, with its thumb set-screw. When the jaws are placed astride of the upright supporting-rod of the stand, and the ring raised a little obliquely upward, the saddle will slip easily into its notch, and when in, if the ring be brought down to a right angle with the rod, it will no longer slip out, but is still loose and free to move up or down on the rod. To fix the ring in any desired position on the rod, it is now only necessary to screw up the thumb-screw; and this not very tightly, lest by unnecessary power the jaws be broken off. This same device is used in all the parts to be supported on the rod, and all are made so nearly alike that the saddles are interchangeable. As by this device these different parts do not slide upon the rod, but are simply loosened from one point and moved to another, and when fastened only touch the rod at three points, the varnish of the parts is much more durable, and therefore the metal less exposed to rust, and to be thereby clogged in the movements of the parts upon each other. For the further protection of the various parts they should always be detached and put away when not in immediate use.

Fourth. Two thin cast-iron plates, *D*, about 16½ inches long by 3½ inches wide, perforated with holes of various sizes, and with long wedge-shaped openings also of various sizes. These serve for very many useful purposes, but chiefly, perhaps, as a funnel and tube-rack, and for the uses of a movable shelf. They also, singly or together, make a fair support for burettes and pipettes. Flasks, test-tubes, or any vessel with a flaring lip may be conveniently supported over any source of heat or for any purpose by means of these various openings. To use the wedge-shaped openings, let the neck of the flask or other vessel with lip, be passed through the larger part of the opening, and then be moved along toward the smaller end until it is arrested by the approaching sides of the opening. At

that point it will hang suspended safely by the lip. If it be not judged safe to trust to the lip, a narrow section of India-rubber tubing stretched over the neck so as to clasp it firmly will form a better rim for support. These sections or rings cut from India-rubber tubing of various sizes are very convenient for suspending flasks, tubes, burettes, &c.

Fifth. A long, narrow, shallow cast-iron pan, *E*, about 17 inches long by 6 inches wide, for sand-bath, drying-table, &c. This also serves for many purposes, but especially for the application of moderate, uniform heat of any desired degree. Half filled with sand, and heated by a burner under one end, it affords various degrees of moderate heat for digestions, evaporations, &c., throughout its length, and with careful regulation of the burner it is capable of doing much useful work.

Figure 1 shows the stand in use for a process of distillation. It is often difficult to make persons understand the best way of distilling comparatively large quantities from small vessels, for example, a gallon of liquid from a two-pint flask, and this and other points are well shown in this illustration.

Upright Condenser.—Retorts are now very little used by those who manage small distillations best. In comparison with a simple flask they are unhandy, difficult to support, generally badly shaped, expensive, and easily broken, while for most purposes they are devoid of counterbalancing advantages. Hence their use is becoming more and more restricted to the distillation of acids. Liebig's condenser was constructed and especially adapted to use with retorts, and now that retorts are less used, a modified condenser better adapted to flasks has been devised and much used by the writer, and is shown in this illustration. The chief objection to a Liebig's condenser of adequate size is the space it takes up on a table. It also permits the loss of much imperfectly condensed vapor by the mere gravity of such vapor. The condenser here offered is a modification of Liebig's, which if it obviates these objections, may be considered an improvement. Like Liebig's it consists of a condensing-tube with a water-case around it,

and appliances for supplying cold water at the distal end and removing warm water from the other, but the condensing-tube is narrow and is doubled upon itself, so that two lengths of it traverse the water-case. From the bend a small T-tube passes out through the lower cork, and the two ends of the condensing-tube pass out through the upper cork. One

Fig. 1.

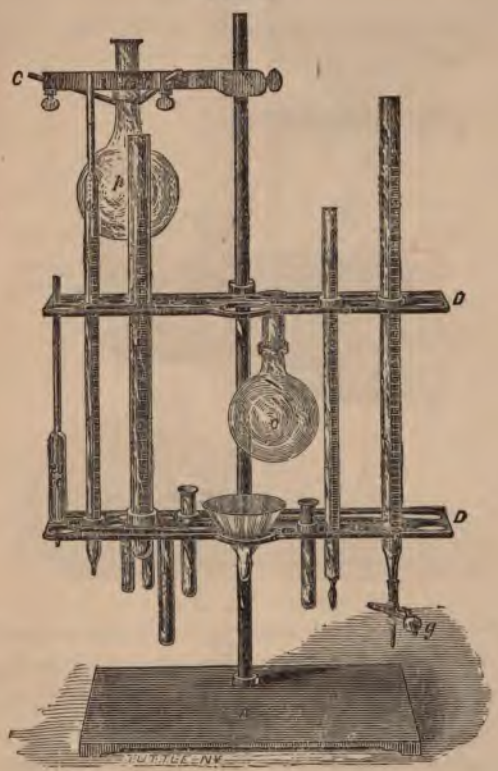
of these ends is longer than the other, bent at right angles over the other, and is widened a little to receive the end of the vapor-tube from the flask. This arrangement at the top avoids the projection of the horizontal end, and enables the condenser to be packed in a straight box for transportation and preservation. Both ends of the condensing-tube

may, however, be left straight, and the right angle bend be given to the tube from the flask. A small straight tube passes through the cork reaching nearly to the lower end, for the cold water supply, and a small bent tube passes through the opposite side of the upper cork to carry off the warm water. Both of these are connected by small india-rubber tubing with proper reservoirs. When the condenser is of small size the external water-case is best made from a piece of large glass tube. If larger, of tin, copper, or brass. The condenser here represented is about eighteen inches long, the condensing-tube about a quarter of an inch internal diameter, and the water-case about one and a quarter inches diameter. When in use the vapor to be condensed enters one leg of the condensing-tube passing downward. The first drops that may be condensed run down and fill the small outlet tube, so that any vapor which fails to be condensed in the first length, fails to find an exit by the small exit tube, and has to rise against its gravity, and against the current of condensed liquid which may be flowing downward toward the exit, and thus encounter conditions most favorable to perfect condensation. This upright condenser is very effective in practice, having nearly double the capacity for the same length of water-case as Liebig's condenser. The size here described will easily condense a pint of water per hour by the use of a gallon of cooling water. The distilling flask *a*, is fitted with an india-rubber cork with three perforations, easily made by means of a sharp wet cork-borer, one for thermometer, one for the vapor-tube, and one for a small feeding-tube. The flask is secured in the sand-bath by small copper wire, and is connected with the condenser *b*, by means of a piece of india-rubber tubing about an inch long, slipped over the ends of the vapor-tube and the condensing-tube where these come together. This is much better and much easier than a connection made by wrapping and tying. The flask *a*, is also connected by a siphon-tube, partly of glass and partly of india-rubber, with the vessel of liquid *d*, to be distilled, which is placed upon the elevated tube-rack *D*, which now serves as a shelf. The flow of liquid from the vessel *d*, into the flask *a*, is controlled to

about the rate of the distillation by a convenient pinchcock g, to be mentioned farther on. The arrangement for supporting the upright condenser by the inverted ring, and india-rubber collar, made of a short section of large india-rubber tubing stretched on to the water-case, and for the water supply to the condenser, are easily understood from the illustration.

Figure 2 represents the tube-racks D, in use for some of

FIG. 2.



the various purposes to which they are applicable, either separately or together; and also represents a mode of suspending a flask p, by means of the ring C, by the use of the india-rubber ring or collar made from a section of tubing stretched over the neck of the flask.

Figure 3 represents the stand in some other of its applications. The rings, *C*, are shown as supporting a capsule, *j*,

FIG. 3.

over a naked flame; and a capsule, *i*, in a water-bath; and a large funnel, *n*. It also shows the long sand-bath, *E*, in use.

Figure 4 shows the ring, *C*, in detail, and shows also

The Pinchcock.—This is a modification and simplification of Bunsen's well-known lever pinchcock for regulating the flow of gases or liquids through flexible tubing. The modification consists in having one screw and milled head instead of two, the place of the second screw being advantageously taken by a simple hinge, and a slight bend near the end of the middle section of wire. This renders it lighter, smaller, and cheaper than Bunsen's, and gives the operator a more

delicate control over the current, and that by one milled head. It is seen open, and the milled head off from the screw

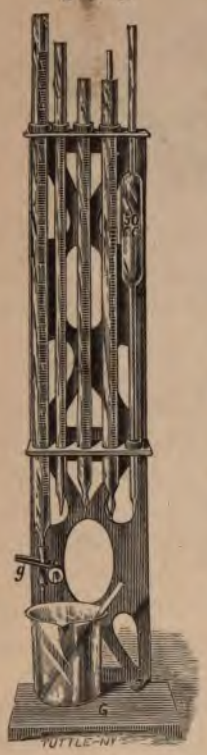
Fig. 4.

at *g*, and in working position just above, with a section of rubber tubing in place, to show the operation of the screw and lever. Three sizes are useful in most laboratories where the value of rubber tubing is duly appreciated, but the two smaller sizes, 1½ and 1¼ inches long, are most useful. The writer, however, uses some 3½ inches long, upon 1-inch hose. They serve to control the stream with the greatest delicacy and nicety, and are very convenient in the use of gas with the Bunsen burner. They are also much better than the spring pinchcock of Mohr for use with burettes, being susceptible of more delicate use with less skill, and any desired rate of dropping being easily and speedily attained. They are particularly convenient upon india-rubber siphons, and supply tubing of all kinds.

Fig. 4 also shows a modification of the grummet, *F*, made of rubber tubing, so useful as a stand for capsules and other round-bottomed vessels. As formerly made, a plug of wood, one-half to one inch long, had the two ends of the piece of tubing slipped upon it until the ends came closely together; each end was then secured by a tack driven through rubber and wood and clinched. When a capsule sets upon such a grummet in a water-bath, the water is apt to boil inside the grummet long before that which is outside becomes heated, and thus cause bumping and other inconvenience, because there is little or no intercommunication between the portions of water. And when a capsule or flask is set upon such a grummet to cool, there is little or no circulation of air round

the bottom. But if three short sections of larger tubing are slipped over the grummet before the ends, *u*, are put together, and be then distributed at equal distances apart on the ring, one section covering the joined ends, the grummet will be much improved. The vessels will then rest upon three points only.

Fig. 5.



These seem to be simple matters to ask the attention of this Association to, but those practically acquainted with the relation between small conveniences and economy of time, will perhaps need no apology for introducing them.

The Burette Stand.—Burettes and pipettes graduated upon the metrical system are now in such common use, and with so much convenience and advantage, that a small stand capable of holding a judicious selection of them seems needed. That selection which is used and advised by the writer as being quite sufficient for all practical purposes is one Mohr's burette of 50 c.c , graduated to fifths ; two Mohr's burettes of 25 c.c., graduated in tenths ; one 10 c.c. pipette, graduated in tenths ; one 5 c.c. pipette, graduated in twentieths ; one pipette of 1 or 2 c.c., graduated in fiftieths or hundredths ; and two capacity pipettes, with a single mark and long points, one of 25 c.c., the other of 50 c.c.

Figure 5 shows a convenient cast-iron stand holding such a set, always in condition for immediate use. Each piece is held in its place by a collar made of a short section of india-rubber tubing stretched over the upper end to prevent its slipping down through the holes in which it rests. When out of use this stand and contents may either stand upright, or for fear of accident, be laid down upon its back. A woodcut of this stand, furnished with the apparatus named, has been pre pared and the block is presented herewith.

Brooklyn, August, 1873.

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